Master Thesis 30 ECTS
2008-05-27

MÄLARDALEN UNIVERSITY
SWEDEN

Analyzing the Term Structure of Credit Spreads on Corporate Bonds over Treasury Using the Extended-Nelson-Siegel Model

Master Thesis in Mathematics with Specialization in Financial Engineering

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Keywords: Nelson-Siegel model, corporate bonds, government bonds, credit spreads, default risk, bond rating, investment grade bonds, speculative grade bonds, spot rate, current yield, forward rate, yield to maturity, zero-coupon bond, accrued interest, duration, floating rate note, forward rate agreement, bullet bond, settlement date.

Acknowledgements: We gratefully acknowledge the valuable help with data, from SEB Capital Markets in Stockholm and Standard & Poor's corporation in London. Further, we would like to thank our supervisor, Consulting Senior Lecturer Jan Röman at the Mälardalen University Department of Mathematics and Physics for his help and comments. Finally, we would like to thank everyone that was present at our presentation of this paper for their suitable comments. Any errors are our own.

ABSTRACT

In this paper we estimate the term structure of credit spreads for different rating categories with an extension of the Nelson-Siegel model. In our study we analyse whether credit spread changes depends on bond characteristics such as rating and maturity.

Our results indicate that credit spread changes especially depend on rating and even if the bond is plus rated, minus rated or flat rated. The credit spread changes also depend on maturity but to a much less significant extent. From our analysis we can see that the lower the rating category and the longer the maturity of the bond the higher credit spread. That means that bonds with lower ratings are more affected than bonds with higher rating. Further, the results from studying the spreads for different investment grade rating categories indicate that credit spreads on plus rated bonds have significantly lower credit spreads than minus rated bonds and that result is in line with our first study.

This paper is written as a master thesis in mathematics with specialization in financial engineering at Mälardalen University department of mathematics and physics and in co-operation with Mälardalen University School of economics. The paper includes 30 ECTS and corresponds to a school term. This thesis is the finishing element for a master degree in mathematics with specialization in financial engineering and will give an insight in the term structure of credit spreads on corporate bonds over treasury using the Extended-Nelson-Siegel Model.

CONTENTS

ABSTRACT

1 INTRODUCTION

This chapter contains an introduction to the subject. A background is presented, followed by a discussion about the purpose of the thesis and will follow with problem specification and discussion and delimitation. Finally the assigned target group is described.

1.1 Background

In late years the corporate bond market has become more liquid and wider. The number of corporate bonds has increased rapidly over the years. Due to this fact it has become more important to study the markets of instruments with default risk, such as corporate bonds.

There is a broad literature on credit risk models but there is little empirical testing of the models. However, we believe that there are several reasons to study the behaviour of credit spreads for different rating categories. In this paper we analyse the term structure of credit spread changes on investment grade Swedish corporate bonds. We have used a large set of data from 2004 to 2007 of Swedish corporate bonds and a large set of Swedish government bonds for our study. The term structure of credit spreads is estimated as the difference in term structure of spot rates on Swedish corporate bonds and Swedish government bonds. We look at credit spreads for several maturities and our study begin with estimating the term structure of credit spreads for investment grade rating categories: BBB, BB, A and AA. Further, we continue with dividing the results between plus rated, minus rated and neutrally rated bonds e.g. AA divides into AA, AA- and AA+. Principally, government bonds are used to estimate the risk-free term structure of spot rates and the corporate bonds are used to estimate the risky term structure of spot rates.

We have divided this paper into 5 parts: In the first section we will give a short introduction to debt securities and the risk they carry. The second section gives an overview of the methodology to extract spot rates using the Extended Nelson-Siegel model and the four measures of fit. In the third section, we first present the data and the estimation results of the term structure of credit spreads. In the fourth section, we analyze the main determinants of credit spread changes for different rating categories and years to maturity. Eventually, the last section concludes.

1.2 Purpose

The purpose of this paper is to examine the term structure of credit spreads which is estimated as the difference in term structure of spot rates on Swedish corporate bonds and Swedish government bonds and test whether bond characteristics such as rating and maturity has any influence on the credit spread changes.

1.3 Problem specification and discussion

We will in particular examine if there is a risk premium in corporate bond spreads and, if so, why it exists. We will extract the term structure of spot rates for different rating categories using the Extended-Nelson-Siegel model. The term structure of credit spreads is estimated as the difference in term structure of spot rates on Swedish corporate bonds and Swedish government bonds.

The Extended-Nelson-Siegel model is used by many central banks. Sweden used the Extended-Nelson-Siegel model until 2001 but is still calculating the Nelson-Siegel parameters to have a backup method. Instruments with high liquidity and low credit risk should be used when estimating the term structure. That is one of the reasons why many countries use government bonds. The data Sweden uses for these calculation are the benchmark government bonds from 2-10 years, Treasury bills with maturities closest to 3,6,9,12 months and the repo rate. They are calculating it on a daily basis and send it once a week to the Bank for International Settlements.[1]

From our analysis we expect that the yields on corporate bonds are higher than the yields on government bonds because government bonds are assumed to be risk-free. Corporate bonds with lower credit rating than AA are more risky than a government bond and should because of that reason generate a higher return. Our study did not result as we expected. We have found that the term structure of spot rates on Swedish corporate bonds are both above and below the term structure of spot rates on Swedish government bonds and there is no academic evidence that basis points can be added to an AAA rated bond to find the yield for a bond with another credit rate.

[1] BIS Papers NO 25,Zero-coupon yield curves: technical documentation, p 27

1.4 Delimitation

As this thesis was to represent 30 ECTS credits, the study is limited to test the Extended-Nelson-Siegel Model. Moreover, we limited the selection of data to only a careful selected set of corporate bonds between the years 2004 to 2007 and our study include investment grade corporate bonds and corporations which have a history in credit rating at Standard & Poor's.

1.5 Target group

Our proposed target group is students studying financial mathematics on advanced level and has read up to Swedish D level at University. Excellent knowledge in statistics and economics are assumed.

2 THEORETICAL FRAMEWORK

In this section, we will explain bonds and the different types of bonds that exist and the risk they carry. Further, we will examine credit spreads and the yield curve. We will also explain why we use spot rates when measuring credit spreads. Moreover, we will discuss possible explanations and evaluate the importance of credit spreads. Finally we will thoroughly explain the Nelson-Siegel model and the extended version.

2.1 An Introduction to Debt Securities

Bonds are securities that represent a loan. Bonds can be issued by a State or a corporation. They give rise to regular payment of coupons, which constitute the interest on the loan, and redemption of the security at maturity. The cash flow is therefore known in advance.

Bonds represent an investment that is less risky than equities, but also less lucrative over the long term. A corporate bond is more risky than a treasury bond and the risk on corporate bonds can be measured in several ways. The credit risk, evaluated according to the quality of the issuer, which is measured by the rating system. The rating, which is made in public, contributes to an efficient market and allows the return on the bond to be linked to its risk. The market risk, or the interest rate risk, is analyzed as a function of the opportunity cost and represented by the difference between the return ensured by the bond and the return of the market for an equivalent maturity.

Bonds are grouped together according to maturity or the quality of the issuer. There are three main types of bonds:

1. Government bonds
2. Municipal bonds
3. Mortgages
4. Corporate bonds

2.1.1 Government Bonds

Government bonds represent the borrowing of the government. Fixed income securities are classified according to the length of time before maturity. These are marketable securities that are known collectively as *Treasurie*s and the three main categories are:

1. Treasury Bills - debt securities maturing in less than one year.
2. Treasury Notes - debt securities maturing in one to 10 years.
3. Treasury Bonds - debt securities maturing in more than 10 years.

All debt issued by the government are regarded as extremely safe. Like companies, countries can default on payments and one should keep in mind that the debt of many developing countries does carry substantial risk. Government bonds are the simplest to

value; they pay interest at a fixed rate and have a stated principal. However, there is one complicating factor; some bonds the government can force the investor to give up at a stated price at the government's discretion i.e. callable bonds. However, this is only true for bonds that are issued before 1985.[2]

2.1.2 Municipal Bonds

Municipal bonds are the bonds next in turn in terms of risk after government bonds. These are debt obligations of states, cities, and state or city authorities. These bonds have default risk, but even if it can happen cities don't go bankrupt that often. The major advantage to a municipal bond is that the returns are free from federal tax but also because of these tax savings, the yield on municipal bonds are usually lower than the yield of taxable bonds.

2.1.3 Mortgage Bonds

Mortgages are debt obligations backed by real estate. Most types of mortgage bonds are issued by mortgage companies, banks, and credit unions. There are different types of mortgage bonds. These include Ginnie Maes, Fannie Mae and Freddie Macs. Further, we will discuss these types and look at how they compare to each other.

2.1.3.1 Fannie Maes

Fannie Maes got its start during the Great Depression, when Congress created the Federal National Mortgage Association in 1938 to help the country lifting itself out of this depression, and did so by creating such agencies. This government program called FNMA or Fannie Mae for short was created as a company who would help low, moderate and middle income families realize what has been referred to as the "American Dream", home ownership. In 1960, Fannie became partially separated from the government and on 1968, the company went public and was listed on the NYSE which would allow them to reach a broader section of the population. Yet, some government connections remain, and Congress continues to provide the charter under which the company operates but provides no financial backing. This government connection allows the company to operate under the guise of being federally backed, giving borrowers and lenders alike added security in the process. Since 1999 Fannie Mae is a publicly traded company and its main consideration is to produce a profit. Fannie Maes do differ from Ginnie Maes and while the backing is only

[2] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 503

perceived in Fannie Mae, it is real in the case of a Ginnie Mae backed security or mortgage.[3]

2.1.3.2 Ginnie Maes

Government National Mortgage Association (GNMA) are mortgages backed by a pool of mortgages and provides a link between capital markets (the lenders) and the Federal Housing markets. This makes Mortgage backed Securities more attractive to investors, such as pension funds and the like. Besides providing a higher return than Treasury notes and having the government's backing against default, Ginnie Maes have another advantage: They are highly liquid and can be resold on the secondary market. Ginnie Maes have a very large minimum investment fee, but one can purchase shares in Ginnie Mae mutual funds for less. The main difference between this company and Fannie Mae lies in the government backing. Further, Freddie Mac and Fannie Mae create mortgage pools that are somewhat larger than those of Ginnie Mae, and investors look to them to also provide a relatively high return compared with other government securities.[4]

2.1.3.3 Freddie Mac

Freddie Mac is also a governmental creation. This company is also a buyer of mortgages on the secondary market. Like Fannie Mae, Freddie Mac provides money to lenders to continue their efforts at selling mortgages. This keeps the market liquid, which is just another way of saying that it will remain funded. Remaining funded means that money will be there it lend, and the interest rates are kept lower as a result. Money supply is the key element here. Freddie Mac, like Fannie Mae, is a publicly traded company and has been for thirty years.[5]

[3] www.bluecollardollar.com 2007-10-01
[4] Ibid
[5] Ibid

2.1.4 Corporate Bonds

A company can issue bonds just as it can issue stock. Corporate bonds represent a loan and are issued by private or public corporations. The three different types of corporate bonds are:

1. Short-term notes – maturing in less than five years
2. Intermediate-term notes/bonds – maturing in five to twelve years
3. Long-term bonds – maturing in more than twelve years

The funds that companies raise from selling bonds are used for a variety of purposes, from purchasing equipment to building facilities to expanding the business.

The corporate bond market is large and liquid and most corporate bonds are traded Over-The-Counter (OTC). This market does not exist in a specific location, it is made up of bond dealers and brokers from around the country who trade debt securities over the phone or electronically. The OTC market is much larger than the exchange markets, and the vast majority of bond transactions take place in this market. Investors in corporate bonds include large financial institutions, such as endowments, pension funds, mutual funds, insurance companies and banks. Individuals, from very wealthy to people of modest means, also invest in corporate bonds because of the many attractions these securities offer.[6]

When an investor is investing in a corporate bond the investor is lending money to the corporation that has issued the bond. In return the corporation promises to return your money paid for the bond on a, for the bond specified maturity date. Until the maturity date the bond pays the investor a stated rate of interest, usually semi-annually. The interest payments you receive from corporate bonds are taxable. However, unlike stocks a bond does not give you an ownership interest in the issuing corporation.[7]

Corporate bonds are characterized by higher yields because there is a higher risk of a company defaulting than the government. The upside is that they can also be the most

[6] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 503-504
[7] Ibid p. 503-504

rewarding fixed income investments because of the risk the investor must take on. Corporate bonds are backed by the credit of the issuing company. It is the company's ability to earn money and meet the obligations of the debt issue that determines the bonds default risk. The higher the quality, the lower the interest rate the investor receives. Generally corporate bonds are divided into investment grade and speculative grade. Although many different types of option features can be present on corporate bonds, callability, sinking funds, and convertibility are the most common. A call provision on a bond gives the issuing company the right to force the bondholder to sell the bond back to the company at a particular price. The price is known and may vary over time. Callable bonds must offer a higher return to compensate the holder for a disadvantageous call since the right to call rest with the company. The sinking fund retirement is intended to prevent the company from having to make one large payment. The company generally has the right of purchasing the bonds in the open market or calling them back to meet the sinking fund. Because of this the investor will require a higher return. However, the presence of a sinking fund lowers the risk that the company will default on the entire issue of bonds or perhaps any of it. Finally, convertible bonds are bonds that can be exchanged for another security, usually common equity.[8]

2.1.4.1 The Huge Attraction in Corporate Bonds

The reason to the huge attraction in corporate bonds is because of a variety of reasons and some of the most important are:

1. Attractive Yields
2. Dependable Income
3. Safety
4. Diversity
5. Marketability

[8] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 503-504

2.1.4.1.1 Attractive Yields

Corporate bonds most often offer higher yields than comparable government bonds. However, this higher yield is accompanied by higher risks.

2.1.4.1.2 Dependable Income

Investors who like a steady income from their investments meanwhile preserving their principal do often include corporate bonds in their portfolios.

2.1.4.1.3 Safety

Corporate bonds are rated and evaluated based on their credit history and ability to repay their obligations. The better ability they have shown to do so the higher the rating and the safer the investment for the investor. We will later on in this paper explain how corporate bonds are rated.

2.1.4.1.4 Diversity

A corporate bond provides the investor to choose from a variety of sectors, structures and credit-quality characteristics to meet the objectives of the investor.

2.1.4.1.5 Marketability

If an investor comes to the point that he/she want to sell a bond before maturity, in most instances he/she can do so easily and quickly because of the liquidity of the market. There are five main classifications of issuers representing various sectors that issue corporate bonds:

1. Public Utilities
2. Transportation Companies
3. Industrial Corporations
4. Financial Services Companies
5. Conglomerates

2.1.4.2 Basic Terms of Corporate Bonds

Earlier in this paper we have already mentioned maturity but there are some other basic terms of bonds that are of importance to cover:

1. Maturity
2. Structure
3. Fixed-Rate
4. Floating-Rate
5. Zero-Coupon
6. Accrued Interest

2.1.4.2.1 Maturity

The maturity is one of the key investment features. The maturity of the bond tells you when you should expect to get your principal back and for how long you can expect to receive interest payments. However, it should be mentioned that some corporate bonds have call or redemption features that can affect the date when your principal is returned. As stated earlier in this paper corporate bonds are just like Treasuries divided into three groups:

1. Short-term notes – maturing in less than five years
2. Intermediate-term notes/bonds – maturing in five to twelve years
3. Long-term bonds – maturing in more than twelve years

2.1.4.2.2 Structure

However, if you do consider buying a corporate bond it is important to know about a bond's structure. When dealing with traditional debt securities the investor lends the issuer a specified amount of money for a specified time. In return for this the investor receives fixed payments of interest on a regular basis for the life of the bond with the total principal returned at maturity.

2.1.4.2.3 Fixed Rate - , Floating Rate- and Zero Coupon Bonds

For the last years the traditional fixed interest rate has been integrated with a mixture of other rates and the most common of these are just Floating Rate and Zero Coupon.

Floating Rate bonds are bonds with variable interest rates that are adjusted periodically according to a specific market rate. However, these kinds of bonds have lower yields than those of fixed rate securities because such bonds offer protection against increases in interest rates.[9]

A Zero Coupon bond does not pay any coupons. Instead they are sold at a deep discount to face value and redeemed for the full face value at maturity.[10]

2.1.4.2.4 Accrued Interest Rate

To be able to price bonds the accrued interest has to be calculated. Accrued interest is the interest earned since the last coupon payment. The accrued interest rate can be calculated as:

$$AI = C \times \frac{360 - d}{360}$$

Where C is the coupon and d are the days since the last coupon.

The year is assumed to have 360 days but that can be changed and depend on the day count convention.

The bond can be priced with either clean price or dirty price and the accrued interest is included in the dirty price. To calculate the accrued interest the day count convention must be known. There are different day count conventions.

[9] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 281
[10] Ibid p. 278

2.1.4.3 Day Count Convention

30/360

Each month has 30 days and the year has 360 days. There are two exceptions. The month is considered to have it actual days if the late date is the last day of February. The month is considered to have its actual days when the later date is the 30th or 31st and the first date is not the 30th or 31st.

2.1.4.3.1 30E/360

Each month has 30 days and the year has 360 days. There is one exception which is that the month is considered to have its actual days if the later date is the last day in February.

2.1.4.3.2 Act/360

The month is considered to have its actual days and the year is considered to have 360 days.

2.1.4.3.3 Act/Act

The month is considered to have its actual days and the year is considered to have its actual days.

2.1.4.3.4 NL/360

The month is considered to have its actual days. There is one exception, when there is a leap year February is considered to have 28 days.[11]

2.1.4.4 Interest Rate Risk

Like all other bonds, corporate bonds rise in value when interest rates fall and fall in value when interest rates rise. By holding a bond until maturity you may be less concerned about these price fluctuations also known as market risk or interest rate risk. A reason to this fact is because you will receive the face value of your bond at maturity. This inverse relationship between bonds and interest rates seem to confuse most investors, but the explanation is essentially straightforward and two of the most obvious explanations are:[12]

[11] Röman © 2007 Lecture notes in Analytical Finance 2, p.14
[12] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 320-322

1. When interest rates rise new issuers will come to the market with higher yields than older securities and because of this, the older securities are now worth less than before and therefore their price will decrease.

2. When interest rates decline new issuers will come to the market with lower yields than the older securities and because of this the older securities are now worth more and therefore their price will increase.

As a result, if you have to sell your bond before maturity, it may be worth more or less than you paid for it.

There are various things that will affect the interest rates both negatively and positively. A rule of thumb is that interest rates typically climb when the economy is growing and fall during economic downturns. Further, rising inflation leads to rising interest rates although at some point higher rates themselves become contributors to higher inflation and moderating inflation leads to lower interest rates. Inflation is one of the most influential forces on interest rates.

2.1.4.5 The Risk Factors That Corporate Bond Investors Face

The risk of default or credit risk is the risk associated with any kind of credit event. It is associated with changes in credit quality which also includes downgrading or upgrading in rating. If a bond is downgraded, it will be perceived as riskier by the market. This may result in a decrease in bond value. Thus, even if no default occurs, a downgrading might influence the value of the bond.

There are three top agencies that deal in credit ratings for the investment world. These are: Moody's Investor Services, Standard & Poor's Corporation and Fitch Investors Service. Standard & Poor's, Moody's and Fitch are financial services companies. They provide credit ratings, equity research, risk solutions and much more. They rate bonds from investment grade to defaultable bonds. Each of these agencies aims to provide a rating system to help investors determine the risk associated with investing. [13]

13 www.standardandpoors.com, www.moodys.com and www.fitchratings.com 2007-08-01

2.1.4.5.1 Rating Categories

In this section we will explain the meaning of the different rating quality's a company can have. We start with investment grade and continue with speculative grade i.e. high-yield bonds.[14] Anything below these grades is already in default. For our analysis we will only use investment grade bonds, but that will be explained further on in this paper.

Default is generally defined as one of the following:

1. Failure of an obligor to make timely payment of principal and/or interest under the contractual terms of any financial obligation.

2. The bankruptcy filings, administration, receivership, liquidation or other winding-up or cessation of business of an obligor.

3. The distressed or other coercive exchange of an obligation, where creditors were offered securities with diminished structural or economic terms compared with the existing obligation.

[14] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 526

2.1.4.5.1.1 Investment Grade

Fitch: AAA

Moody's: Aaa

Standard & Poors: AAA

Bonds that are rated like this have the highest credit quality and this rating denote the lowest expectation of credit risk. Investment payments are protected by an exceptionally strong capacity for payment of financial commitments. This capacity is highly unlikely to be adversely affected by foreseeable events.

Fitch: AA

Moody's: Aa

Standard & Poors: AA

Bonds that are rated with Standard & Poor's AA are judged to have a very high credit quality and this rating indicates expectations of very low credit risk. They indicate very strong capacity for payment of financial commitments. This capacity is not significantly vulnerable to foreseeable events. They are rated lower than the best bonds because investment payments may not be protected by an exceptionally strong capacity for payment of financial commitments as higher rated bonds.

Fitch: A

Moody's: A

Standard & Poors: A

Bonds that have Standard & Poor's rating A are to be considered as upper medium-grade obligations. This rating denotes expectations of low credit risk. The capacity for payment of financial commitments is considered strong, but elements may be present that suggest a susceptibility to impairment sometimes in the future.

Fitch:	BBB
Moody's:	Baa
Standard & Poors:	BBB

This is the lowest investment grade category and these ratings are neither highly protected nor poorly secured. This is a good credit quality and this rating indicates that there are currently expectations of low credit risk. The capacity for payment of financial commitments is considered adequate but adverse changes in circumstances and economic conditions are more likely to impair this capacity.[15]

2.1.4.5.1.2 Speculative Grade

Fitch:	BB
Moody's:	Ba
Standard & Poor's:	BB

Bonds that are rated in this category are not investment grade and are judged to have speculative elements. It indicates that there is a possibility of credit risk developing, particularly as the result of adverse economic change over time; however, business or financial alternatives may be available to allow financial commitments to be met.

Fitch:	B
Moody's:	B
Standard & Poor's:	B

Bonds that are rated B are highly speculative and do generally lack characteristics of the desirable investment. They indicate that significant credit risk is present, but a limited margin of safety remains. Financial commitments are currently being met; however, capacity for continued payment is contingent upon a sustained, favourable business and economic environment.

[15] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 526

Fitch:	CCC
Moody's:	Caa
Standard & Poor's:	CCC

Bonds that are rated in this category are of poor standing and default is a real possibility. These bonds may be in default and their capacity for meeting financial commitments is solely reliant upon sustained, favourable business or economic conditions.

Fitch:	CC
Moody's:	Ca
Standard & Poor's:	CC

For bonds that are rated in this category default of some kind appears probable.

Fitch:	C
Moody's:	C
Standard & Poor's:	C

For bonds that are rated in this category default is imminent.[16]

The credit risk is also associated with changes in credit spreads, and the default event etc. The default risk of a bond is the possibility that the bondholder does not receive the payments stated in the contract, such as principal amount and interest payments.

The credit risk of a bond arises because the level and the timing of payoffs to investors may be uncertain. Because of this uncertainty, the corporate bonds should offer higher yields than comparable default free bonds, i.e. Treasuries. Consequently, a corporate bond trades at a lower price in terms of maturity and coupon than a corresponding government bond. The difference between the yield on the risky bond and the yield of the corresponding default free bond is called the credit spread. In turn, Credit spread changes can be easily viewed as an excess return of corporate bonds over Treasuries. The credit spread will be discussed and explained later on in this paper.

[16] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 526

2.1.5 Duration and Convexity

The duration of a bond is the weighted average of the bonds maturity and measures the time it takes for the bond to be profitable. The duration of a zero-coupon bond is equal to its maturity and the duration for a coupon bearing bond is less than its maturity. The duration can also be interpreted as the first derivative of the bond price with respect to the interest rate. Duration or Macaulay's duration can be expressed as

$$D = \frac{1}{P}\sum t_i C_i e^{-yt_i}$$

or as

$$D = \frac{1}{P}\left[\frac{N}{\left(1+\frac{YTM}{100}\right)^n} + \sum_{i=1}^{n}\frac{C\times i}{\left(1+\frac{YTM}{100}\right)^i}\right]$$

Where P is the present value of the bonds price, C is the coupon size, N is the nominal amount and n is the number of years to maturity. Duration can be a risk measure and a long duration means a higher risk because it takes longer before the bond is profitable.[17]

An interest change doesn't usually result in a linear change of the bond price as the duration measures it. It is usually a curved function and the convexity measures the curvature of the bond price. Convexity is the second derivative of the bonds price with respect to the interest rate. The convexity can be expressed as.[18]

$$D = \frac{1}{P}\frac{\partial^2 P}{\partial y^2} = \frac{1}{P}\left[t_i^2 C_i e^{-yt_i}\right]$$

or as

$$Convexity = \frac{1}{P}\left[\sum\frac{C}{\left(1+\frac{YTM}{100}\right)^i}\times\left(n^2+i\right)\right]$$

[17] Röman © 2007 Lecture notes in Analytical Finance 2, p.87
[18] Ibid p.90

2.1.6 The Government Bond – and Corporate Bond Yield Curve

Swedish government bonds and government bonds in general have almost no default risk and all bonds are from one issuer so the uncertainty about date and amount of payments is reduced. Also as previously stated, most government bonds do not have any special provisions such as call features, making it possible to use only bonds without options for the estimation process. Since the quality of data sets available for Swedish government bonds is very high, yield curve estimation can be done with high accuracy. However, for corporate bonds the situation is different. Compared to the Swedish government yield curve there are several important new factors that influence the corporate bond yield curve that will arise. The most important of these factors is the default risk, that is, the risk that the issuing company is not able or perhaps not willing to complete their obligations to pay coupons or pay back the face value of the bond. Corporate bond holders ask for a premium to compensate for the default risk that they face. This may be significant in the case of low rated issuers. Further, corporate bonds have a lower liquidity so an investor of corporate bonds also has the risk of not being able to sell at every point in time. Compared to government bonds, corporate bonds also have different tax regulations and a larger share of bonds with call provisions or other special features. As corporate bonds face more risk factors, investors will ask for a premium for taking on these risks.[19]

2.1.7 Exemplifying Credit Spreads

The yield curves for corporate bonds are significantly higher than for government bonds. Reasons for that are that observed credit spread are credit risk and a risk premium that investors ask for taking on this risk. This will be explained in more detail below. What is credit risk? Credit risk refers to the possibility that a company might default or that the rating of the company worsens, so that the bond loses value. Further factors responsible for the spread are options included in the bond, liquidity, and taxes. When we study the impact of credit risk we will sort the bonds by ratings according to Standard & Poor's corporation.

As previously stated the corporate bond yield curve consists of the government bond yield curve and the credit spread curve. Therefore, the corporate bond yield curve will move more or less closely with the government bond yield curve depending on how much and in which direction credit spreads change. The credit spread can be viewed as the premium

[19] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 288ff

that investors ask for because of the "extra" risk they take upon when investing in corporate bonds and therefore the interest rate on government bonds is seen as the risk less interest rate. This section will discuss possible explanations and evaluation the importance of credit spreads.

As previously explained the credit spread is defined as the difference between the yield to maturity on a corporate bond and the yield to maturity on a government bond of the same maturity, that is, an alternative for corporate bond excess loss:

$$\text{Credit Spread}_t = ytm_t CB - ytm_t GB$$

Where *ytm* is the yield to maturity.

The credit spreads should differ across rating classes. Further, the credit spreads should also be positive for each rating class because of default risk, tax premium, risk premium, and liquidity that corporate bonds come with. These are the most important factors for explaining credit spreads. All in all, these four components explain most of the credit spread. The four components are explained in more detail below:[20]

2.1.7.1 Default Risk

It will happen that some corporate bonds will default because corporations face a significantly higher default risk than Treasuries, which introduces a significant higher default risk for corporate bonds and therefore investors will require a higher promised payment to compensate for the expected loss from defaults. For estimating the yield curve, companies should have a comparable risk class. The yield curve can be estimated using rating as an indicator for default risk. The estimation of the yield curve is made using only bonds of companies with a certain rating provided by Standard & Poor's corporation. When valuing liabilities, one should also account for default risk. When investing the amount equivalent to discounted liabilities, one probably would not be able to service the liabilities because some bonds in the portfolio will default. The credit spread due to default risk is higher the lower the rating of the company is.[21]

[20] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 280ff
[21] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 288ff

2.1.7.2 Tax Premium

Another reason for the spread is the different tax regulations for corporate and government bonds. Interest payments on government bonds are subject only to federal taxes, whereas corporate bonds are also taxed at the state level, from which government bonds are exempt. Because of that the investor will earn only interest reduced by taxes. This is why corporate bonds have a tax premium. Taxes account for a large part of the credit spread between government bonds and corporate bonds.[22]

2.1.7.3 Risk Premium

Investors should require a premium for the higher risk since the return on corporate bonds is riskier than the return on government bonds. The credit spreads on corporate bonds vary systematically with the same factors that affect common stock returns. So, if investors in common stocks require compensation for this risk, so should investors in corporate bonds. Due to the fact that the systematic market risk can not be diversified the risk premium is a large part of the credit spread.[23]

2.1.7.4 Liquidity

Liquidity certainly plays a role, but the size of its effect is probably quite small. One pricing error related to corporate bonds is a price discount for corporate bonds that do not have much liquidity. The risk of liquidity introduces the risk that investors of corporate bonds might not be able to sell the bond at the time they want to. For this "extra" risk they expect a premium, which leads to a discount on the price. Further, the bond prices usually are averages of dealer quotes. For bonds with a low liquidity, dealers might not update their quotes regularly because there is not much business to attract. This can result in prices that no longer reflect the market prices.[24]

However, one should note that the default risk, tax premium, risk premium, and liquidity have only limited influence to explain the changes in the credit spreads. The remaining spread after adjusting for these factors is explained in large part by proxies for systematic risk factors in the stock market.

[22] Ibid p. 280ff
[23] Ibid p. 280ff
[24] Ibid p. 280ff

As pointed out previously we define credit spreads as the difference in yield to maturity on a zero coupon corporate bond, the corporate bond spot rate and the yield to maturity on a zero coupon government bond of the same maturity, the government bond spot rate. Further ahead in the paper when we will refer to this rate we will refer to it as the "spot rate" rather than the longer expression yield to maturity on a zero coupon. However, we will start with defining the many definitions of rates that exist.

The rate that most common used rate to compare bonds is the yield to maturity. The method used to calculate yield to maturity varies across bond categories and therefore the results may not be comparable. Basically, yield to maturity is the internal rate of return earned from holding a bond to maturity. Although it is the most common rate used the yield to maturity have some disadvantages. The yield to maturity is the return if all cash flows received before the horizon is invested at the yield to maturity at the horizon.[25] Another type of rate is current yield. Current yield is simply the annual coupon payment divided by the price. Current yield is the yield you see in newspapers. The current yield has very limited usefulness. Current yield is not the return of the bond if held at maturity and it's not the expected return of the bond over the year. The current yield on a bond that does not pay interest is zero. If you were to invest in a bond based of current yield you would with most certainty reject bonds with low coupons but large returns in form of capital gains. The current yield is the coupon rate divided by the market price of the bond. Another type of interest rate is the spot rate. The spot rate is the yield to maturity on bonds that pay only one cash flow to the investor of the bond and they have a great importance when valuating bonds. A reason for that is that is bonds are not priced at a price equal to the present value of their present value of their cash flows discounted at the spot rate, profitable swaps will exist. A final type of interest rates that we will explain here is the forward rate. The forward rate is the interest rate on bonds where the date when the obligation is made and the date the money is loaned are dissimilar.

The basic reason why we will use spot rates rather than yield to maturity on coupon debt in our study are that arbitrage arguments hold with spot rates and not with yield to maturity. Because a risk less coupon paying bond can always be expressed as a portfolio of zeros,

[25] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 507

spot rates are the rates that must be used to discount cash flows on risk less coupon paying debt to prevent arbitrage. This is however not true for yield to maturity. In addition, the yield to maturity depends on coupon. Thus, if yield to maturity is used to define the spread, the spread will depend on the coupon of the bond that is picked. Finally, calculating spread as difference in yield to maturity on coupon-paying bonds with the same maturity means one is comparing bonds with different duration and convexity. The disadvantage of using spots is that they need to be estimated.

2.1.8 Explaining the Yield Curve

We have in our study seen that while yields to maturity on bonds of various maturities are reasonably similar, yields do differ. Bonds with shorter maturities generally offer lower yields to maturity than longer term bonds (see graphs later). The graphical relationship between yield to maturity and the term to maturity is called the yield curve. The same relationship is also known in the literature as term structure of interest rates because it relates yields to maturity to the term of each bond. Basically we can say that the yield curve or term structure of interest rates is the function that associates the level of the interest rate with each maturity. To predict the future value of the rate instrument to be predicted one can measure the current rates, forecasting future rates and anticipating shifts in the yield curves. The yield curve can be constituted through observation of the prices of financial instruments, by establishing a relationship between the maturities of the securities and the levels of rates. Two alternatives exist: using yield to maturity or using zero-coupon rates.[26]

2.1.8.1 Yield to Maturity and Zero-Coupon Rates

An investor that is considering purchasing a bond is not quoted a promised rate of return. Therefore, instead the investor must use the maturity date, bond price, and coupon payments to infer the return offered by the bond over its life. We can therefore define the yield to maturity as the discount rate that makes the present value of a bond's payment equal to its price. The yield to maturity of a bond is defined as the rate that makes its quotation price equal to the discounted sum of its future cash flows $(F_i)i = 1,...,n$ or

[26] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 304ff

$$P = \sum_{i=1}^{n} \frac{F_i}{(1+r)^i}$$

Where *n* is the number of periods and *i* is the interest rate period.[27]

Excel provides a function for yield to maturity and that is:
=Yield(settlement date, maturity date, annual coupon rate, bond price, redemption, value as percent of par value, number of coupon payments per year)

The equation above has only one unknown variable, the interest rate, *r*. The bond's yield to maturity is the bond's internal rate of return, but the use of *r* to define the return that is actually obtained for the bondholder presents a certain number of disadvantages. In order for the rate to correspond to the return obtained at maturity, we must be able to reinvest the coupons at the same rate as *r*, which is not necessarily the case. In addition, this definition of the rate assumes that the yield curve is flat and that each bond has its own interest rate, while we would wish to have a term structure for the rates with a single rate associated with each maturity. To achieve this, we turn to zero-coupon bonds.

A zero-coupon security is a security that only pays out a single cash flow at its expiry date. Let B_t be the elementary zero-coupon security paying out one euro at date *t*. The zero-coupon price and its maturity rate of return respect the following relationship:

$$B_t = \frac{1}{(1+r_t)^t}$$

assuming that the reference date is 0.

The complete set of rates, r_t for the different zero-coupon maturities allows us to define the range of zero-coupon rates. The use of zero-coupon rates allows us to construct a yield curve that associates a single rate with each maturity. The curve that is thereby obtained is then used as a basis for valuing rate instruments and measuring the risks. Any bond that

[27] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 288ff

pays out, F_i cash flows at dates t_i, $i = 1,...,n$, can be modelled by a portfolio of zero-coupon securities, with each cash flow considered to be a zero coupon.[28]

The number of zero-coupon securities traded on the markets is not sufficient to allow a direct estimate of the yield curve using those securities. Several models have therefore been proposed using Treasuries with maturities that allow all yield curves to be covered. These bonds are coupon bonds. In this case, each coupon is equated to a zero-coupon security with a maturity that corresponds to the date on which the coupon falls. The Nelson-Siegel model allow the zero-coupon rates to be constructed theoretically.

The yield curve can be built from prices in the bond market or from prices in the money market. Government bonds are used if the yield curve is built from bonds. Instruments used from the money market could be LIBOR rates, futures and interest swaps.

The yield curve can be represented in three different ways. It can be represented by the yields from discount bonds. It can also be represented by associating the continuously compounded spot rate[29]

$$R(t,T)$$

with the discount bond price

$$P(t,T) = \exp\left[-R(t,T)(T-t)\right]$$

Which gives

$$R(t,T) = \frac{-\ln\left[p(t,T)\right]}{T-t}$$

The third way is in term of the forward rate

$$f(t,T) = \frac{\partial\left[\ln\left[p(t,T)\right]\right]}{\partial T}$$

Then the discount function can be written as

$$p(t;T) = \exp\left[-\int_t^T f(t,u)du\right]$$

and the spot rate as

[28] Bodie, Kane, Marcus © 2007 Essentials of investments 6th ed p. 296ff
29 Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. ?

$$R(t,T) = \frac{1}{T-t}\int_t^T f(t,u)du$$

When deriving the term structure of interest rates either the yield errors or the price errors can be minimized. For instruments with a short maturity the minimizing of price errors can lead to a large yield error. To give an equal weight to each bond without consider that the bonds have different durations leads to over fitting of long term bonds with the expense on the shorter term bonds. A small change in the yield results in a small change in the price of a bond with short maturity and a large change in the price of a bond with longer maturity. To solve this problem the bonds can be weighted by the inverse of its duration.[30]

The trading volume of a bond can decrease when it is close to its maturity and this can result in a large yield error because the quoted price may not reflect the price when trading took place.[31]

2.2 The Nelson-Siegel Model

A parsimonious functional description of the forward curve was proposed by Nelson and Siegel in 1987.

$$f(t,s) = \beta_0(t) + \beta_1(t)\times\exp\left\{-\frac{s}{\tau_1}\right\} + \beta_2(t)\times\frac{s}{\tau_1}\times\exp\left\{-\frac{s}{\tau_1}\right\}$$

However, it was extended by Svensson in 1994. That model includes an extra polynomial-exponential term: [32]

$$f(t,s) = \beta_0(t) + \beta_1(t)\times\exp\left\{-\frac{s}{\tau_1}\right\} + \beta_2(t)\times\frac{s}{\tau_1}\times\exp\left\{-\frac{s}{\tau_1}\right\} + \underline{\beta_3(t)\times\frac{s}{\tau_2}\times\exp\left\{-\frac{s}{\tau_2}\right\}}$$

If we integrate the Nelson-Siegel forward rate expression above we will get:

30 BIS Papers NO 25,Zero-coupon yield curves: technical documentation, pVIII
31 Ibid
32 Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. 102

$$r(t)=\frac{1}{t}\int_0^t\left[\beta_0(t)+\beta_1(t)\times\exp\left\{-\frac{s}{\tau_1}\right\}+\beta_2(t)\times\frac{s}{\tau_1}\times\exp\left\{-\frac{s}{\tau_1}\right\}\right]ds$$

Further, if make the following change in variables we will get:

Variables: $s=\frac{x}{\tau_1}$ and $ds=\tau_1 dx$ [33]

$$r(t)=\beta_0(t)+\frac{\beta_1(t)\tau_1}{t}\int_0^{t/\tau_1}e^{-x}dx+\frac{\beta_2(t)\tau_1}{t}\int_0^{t/\tau_1}x\times e^{-x}dx$$

$$=\beta_0(t)+\beta_1(t)\frac{\tau_1}{t}\left[e^{-x}\right]_0^{t/\tau_1}+\beta_2(t)\frac{\tau_1}{t}\left\{\left[-xe^{-x}\right]_0^{t/\tau_1}-\int_0^{t/\tau_1}e^{-x}dx\right\}$$

$$=\beta_0(t)+\beta_1(t)\left[\frac{1-e^{t/\tau_1}}{t/\tau_1}\right]+\beta_2(t)\left[\frac{1-e^{t/\tau_1}}{t/\tau_1}-e^{t/\tau_1}\right]$$

This implies the spot yield curves below.

Nelson and Siegel proposed a model for the yield curve, $r^{NS}\left(t,\Theta^{NS}\right)$. A model that was extended by Svensson in 1994, $r^{ENS}\left(t,\Theta^{ENS}\right)$.

The Nelson-Siegel formula can be written:

1. $$r_{t,j}^{NS}\left(m_t,\Theta^{NS}\right)=\beta_0(t)+\beta_1(t)\left(\frac{1-\exp\left\{-m_t/\tau_1\right\}}{m_t/\tau_1}\right)+\beta_2(t)\left(\frac{1-\exp\left\{-m_t/\tau_1\right\}}{m_t/\tau_1}-\exp\left\{-m_t/\tau_1\right\}\right)+\varepsilon_{t,j}$$

And the Extended-Nelson-Siegel formula can be written:

[33] Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. 102

2. $$r_{t,j}^{ENS}\left(m,\Theta^{ENS}\right)=\beta_0+\beta_1\left(\frac{1-\exp\left\{-m_t/\tau_1\right\}}{m_t/\tau_1}\right)+\beta_2\left(\frac{1-\exp\left\{-m_t/\tau_1\right\}}{m_t/\tau_1}-\exp\left\{-m_t/\tau_1\right\}\right)+\beta_3\left(\frac{1-\exp\left\{-m_t/\tau_2\right\}}{m_t/\tau_2}-\exp\left\{-m_t/\tau_2\right\}\right)+\varepsilon_{t,j}$$

with $\varepsilon_{t,j}\tilde{}N\left(0,\sigma_j^2\right)$

We denote the spot rate at time t, $j=\{AAA, AA, A, BBB \text{ and } BB\}$ by $r_{t,j}$ and maturity m of the bonds. The yield curve $\Theta^{NS}=\left(\beta_0,\beta_1,\beta_2,\tau_1\right)$ and $\Theta^{NS}=\left(\beta_0,\beta_1,\beta_2,\beta_3,\tau_1,\tau_2\right)$ for the Extended-Nelson-Siegel are some smooth yet flexible functions representing the interest rates as a function of maturity m. We have implemented the model in Excel. We estimate the parameters $\left(\beta_0,\beta_1,\beta_2,\beta_3,\tau_1 \text{ and } \tau_2\right)$in the Extended-Nelson-Siegel model by minimizing the sum of squared bond price errors weighted by $(1/\Phi_j)$:

$$\underset{\beta_0,\beta_1,\beta_2,\beta_3,\tau_1,\tau_2}{Min}\sum\left\{\left[P_j-P_j^{ENS}\left(\beta_0,\beta_1,\beta_2,\beta_3,\tau_1,\tau_2\right)\right]/\Phi_j\right\}^2$$

Where Φ equals the duration$\times$price / (1 + yield to maturity) of the bond.

The advantage of the Nelson-Siegel model is.

1. The model work well on interest rate data
2. The yield curve converges to a constant value $\lim_{t\to\infty} r(t)=(\beta_0)$.
3. We can interpret the basis functions, given by:

$$\varphi_1=1$$

$$\varphi_2=\frac{1-e^{-\lambda_1 t}}{\lambda_1 t}$$

$$\varphi_2=\frac{1-e^{-\lambda_1 t}}{\lambda_1 t}-e^{-\lambda_1 t}$$

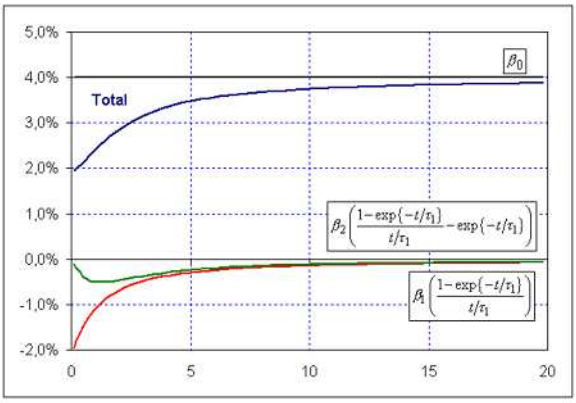
Where φ_1 denotes the parallel shift, φ_2 the tilting and φ_3 the flexing. Where λ_1 is a fixed coefficient that determines the exponential decay of the first and second component in the Nelson-Siegel model.[34]

As previously explained the shape and the form of the yield curve are determined by the three components (four in the extended version) and their associated weights in β_t. The first component β_0 takes the value 1 (constant) and can for that reason be interpreted as the overall level that influences the long-run level of interest rates. The second component β_1 converges to one as τ decreases to zero and converges to zero as τ approaches infinity (∞) for a given t. Because of that this component mostly influences short-term interest rates. The third and last component in the Nelson-Siegel model β_2 converges to zero as τ decreases to zero and as τ approaches infinity (∞) but is concave in τ, for a given t. This component is therefore the medium-term component. If the time to maturity *m* goes to infinity, the spot rate converges to β_0. If *m* goes to zero, the spot rate converges to $\beta_0 + \beta_1$. To avoid negative interest rates, β_0 and $\beta_0 + \beta_1$ should be positive. β_0 can be interpreted as the long-run interest rate and $\beta_0 + \beta_1$ as the instantaneous interest rate. This implies that $-\beta$ can be interpreted as the slope of the yield curve and the slope of the curve will be negative if β_1 is positive and positive if β_1 is negative. β_1 also indicates the speed at which the curve evolves towards its long-run trend. The third component in the Nelson-Siegel model β_2 determines the magnitude and the direction of the hump or through the yield curve. The parameter τ_1 is a time constant that should be positive in order to assure convergence to the long-term value β_0. This parameter specifies the position of hump or through the yield curve.

Given that the first component is the only one that equals one as τ approaches infinity (∞), its resultant β_0 coefficient is usually linked with long-term interest rate.

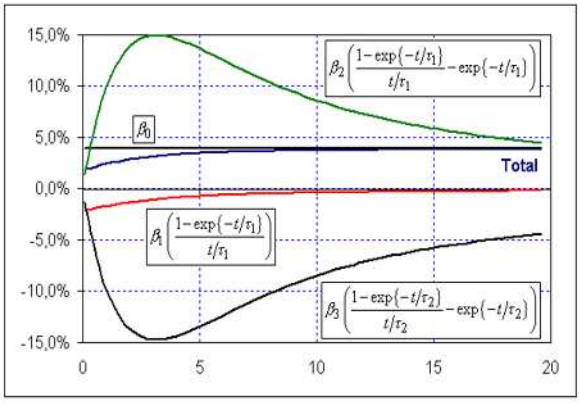
[34] Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. 103

This is illustrates in the figures below, which shows the basis functions for the two models where we have fitted the parameters to the Swedish Bonds used in the bootstrap above:



Source: Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. 103

Nelson-Siegel Model



Source: Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. 103

Extended-Nelson-Siegel Model

The Extended-Nelson-Siegel model can be fitted to a yield curve with two maximum. However, there exists a disadvantage with model: Sometimes there exist numerical problems that do not exist in the Nelson-Siegel model.[35]

[35] Jan Röman © 09/01/2008, Lecture notes in Analytical Finance 2, p. 105

3 EMPIRICAL ANALYSIS

In this section, we will explain the method used to estimate the credit spreads for corporate bonds over Treasuries. We will thoroughly explain how the work was implemented.

3.1 Practical Methodology

We have received corporate bond data from SEB Capital Markets in Sweden. The data contains settlement date, maturity date, and yield to maturity for different Swedish corporate bonds. It is daily data from 2004 to 2007. To our help we have had historical credit ratings for Swedish bonds. This data has been sent to us by Standard & Poor's credit rating agency in London. Moreover, we have received daily data on the Swedish government bonds that pay coupons and Treasuries with maturities 1,3,6,9 and 12 months. This data has been given to us by senior lecturer J. Röman. Further, the data on U.S. and Euro yield are from Bloomberg. We trust that our sources are correct and trustworthy.

There are not enough zero-coupon bonds to be used to calculate the spot rates. Zero-coupon rates can be found from government bonds and there are different methods for finding them.
One model is the Nelson-Siegel that is a parametric model which means that a spot rate can be found for every maturity.

3.1.1 Finding the Credit Spreads with the Extended-Nelson-Siegel Model

We will use the Extended-Nelson-Siegel model to estimate credit spreads on corporate bonds over Treasuries. The basic suggestion of the Nelson-Siegel model is to fit the empirical form of the yield curve with a pre-specified functional form for the spot rates, which is a function of the time to maturity of the bonds.

So why do we use the spot rate? The reason for that is simply because the yield to maturity depends on the coupon rate. The yield to maturity of bonds with the same maturity but different coupons may vary considerably. Then, the credit spread will depend on the coupon rate. Moreover, if we use yield to maturity to calculate the credit spread, we will end up comparing bonds with different duration and convexity. A disadvantage of spot rates is that they are not observable. They need to be estimated. We will use the Extended-Nelson-Siegel model, introduced by Nelson and Siegel in 1987 to extract the spot rates for the different investment rating categories. We will make a distinction between four rating categories: A, AA, AAA, BB and BBB. The Extended-Nelson-Siegel model offers a conceptually simple and parsimonious description of the yield curve. As referred to above

it avoids over-parameterisation while it allows for monotonically increasing or decreasing credit spreads and hump shaped yield curves.[36]

3.1.2 Data Description

Before we construct our sample of corporate bonds we start by excluding bonds for which there is no rating available in our historical file from Standard & Poor's. Further, we will also exclude bonds that have no yield and maturity available. Finally, we exclude all bonds which have more errors in their data. Then we will take a carefully chosen set of settlement dates randomly over the period 2004 to 2007. These filters leave us with a data set of approximately 500 corporate bonds issued by 25 firms. The credit rating is the most widely observed measure of credit quality. We make a distinction between four investment grade rating categories: A, AA, BB and BBB. Below is a table of how many corporate bonds that we have looked at for each year and each rating category and in all unique corporate bonds that we test can be found in Appendix. If a bond is downgraded to a speculative grade rating i.e. below BBB or matured, it is removed from the sample.

Finally, data on how many bonds that are available for the different default risk classes after carefully sorted out all the errors we have the following:

Rating/Year:	2004	2005	2006	2007	Total No of CBs:
A	17	28	24	22	91
A-	63	95	54	66	278
A+	14	25	27	25	91
AA	27	-	10	19	56
AA-	43	48	40	33	164
AA+	6	-	26	30	62
BB+	7	7	-	-	14
BBB+	117	71	62	77	327
BBB-	-	-	1	1	2
Total No of CBs:	294	274	244	273	

In Appendix there are graphs showing the corporate bonds yields and the corresponding Nelson-Siegel yields for different maturities. In the data that we use there are some bonds that are "Bullet" bonds. A "Bullet" bond is basically a bond that is not able to be redeemed prior to maturity. A bullet bond is usually more expensive than a callable bond (in that the interest rate is lower), since the investor is protected against the possibility of the bond

[36] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 512ff

being called when market interest rates fall. Finally, when we construct the yield curve we sort the data by default risk of the company.

3.1.3 The Model

The model we use is the extended version of the Nelson-Siegel model. We have built a program in Excel Visual Basic to calculate the spot rates using that method. The solver in Excel is used to minimize the squared error between the Treasury yield and the Nelson-Siegel yield weighted by $(1/\Phi_j)$ to find the constants, where Φ equals the duration$\times$price / (1 + yield to maturity) of the bond.

4 RESULT

In this section, we will thoroughly go through the results from our calculations.

4.1 Result

Changes in credit quality which also includes downgrading or upgrading in rating is part of credit risk. A general process of improvement or worsening in the credit quality should inversely move the credit spreads. A better credit quality reduces credit spread. Even if the probability of default remains constant for a firm, changes in credit spreads can occur due to changes in the market.

The corporate spread we examine is the difference between the spot rate on corporate bonds in a particular rating class and spot rates for Treasury bonds of the same maturity. In Appendix we can see Treasury spot rates as well as corporate spreads for our sample for the three following rating classes: AA, A, and BBB for all maturities too. AAA and BB bonds were excluded because for most of the period studied, the number of these bonds that existed was too small to allow for accurate estimation of a term structure of spots.

We have seen that the spreads depends on the time to maturity of the corporate bond. If we look at highly rated corporate bonds we have two possibilities for the credit rating either will the rating stay stable either will the rating decline. If a corporation has a lower rating perhaps it has a higher probability of default in the short run. A corporation that pass the first years tend to evolve to a higher rating while the higher rated tend to decrease to a lower rating. This implies a mean-reversion of ratings as well as credit spreads. In this paper, we concentrate on the investment grade bonds (A-, A, A+, AA, AA-, AA+, BB+, BBB+ and BBB-) and therefore we expect to find an increasing credit spread. As previously explained corporate bonds rated below BBB were excluded because data on these bonds was not available for most of the time period we studied.

From our analysis we can see that the lower the rating category and the longer the maturity of the bond the higher credit spread. Further, looking at the spreads for each rating category we can see that credit spreads on plus rated bonds have significantly lower credit spreads than minus rated bonds.

The program built in Excel has been run for the dates that we have carefully chosen and we established the following values for the parameters β_0, β_1, β_2, β_3, τ_1 and τ_2.

TABLE 2: Parameters	2004-04-02	2005-01-03	2006-04-18	2007-01-02
Long-run levels of interest rates, b0	10,1546	10,1546	10,2265	10,361
Short-term component, b1	-10,135	-10,1349	-10,2072	-10,3314
Mediem-term component, b2	-3,4493	-3,4545	-3,197	-3,0803
Parameter b3	-24,874	-24,8742	-24,7697	-24,852
Decay parameter, t1	6,0875	6,0947	6,3443	6,5172
Decay parameter, t2	22,6827	22,681	22,583	22,4701

When we run the program with these values we get the graphs shown in Appendix for the yield curve. Further, we have found the following mean and standard deviation for the error.

	2004-04-02	2005-01-03	2006-04-18	2007-01-02
Mean	0,000027	-0,0000033	0,0000077	-0,0000179
Standard Deviation	0,0004279	0,0004921	0,0006356	0,0008838

It can be seen from the graphs that the corporate yields can be both higher and lower that the Nelson-Siegel yield. All the graphs can be found in Appendix. For the bonds from 2004 rated A there are 7 yields that are less than the Extended-Nelson-Siegel yield and 14 that are higher. For the bonds that are rated A- there are 5 that are lower and 58 that are higher then the Extended-Nelson-Siegel rate. The spread fluctuates a lot. For A+, AA+ and 04 BB+ all the yields are above the Nelson-Siegel yield. 4 yields are lower and the rest are higher for the AA rated bonds. For the BBB+ rated bonds 13 are lower and 105 are higher and the spread fluctuation is big.

For the bonds from 2005 that are rated as A there are 7 yields that are lower and 21 that are higher. There are 27 yields that are lower and 68 that are higher for the A- rated bonds. The spread differs a lot for the different bonds for both A and A- rated bonds. For A+ there are 3 yields that are lower and 22 that are higher and for BBB+ rated bonds 22 are lower and 49 are higher. All the yields are higher for the bonds rated BB+.

For 2006 there are 10 yields that are lower than the Extended-Nelson-Siegel yield and 14 yields that are higher for bonds rated A. The bonds rated A- there are 8 yields that are lower and 46 that are higher. The spread differs a lot for the different bonds for both A and A- rated bonds. For the A+ rated bonds 5 are lower and 22 are higher then the Extended-Nelson-Siegel yield. There are 4 yields rate lower and 6 rated higher for the AA rated bonds and 7 lower and 33 rated higher for the AA- rated bonds. 9 yields are lower and 17 are higher for the AA+ rated bonds. For BBB- there is only 1 corporate bond and that yield

is a lot higher than the Extended-Nelson-Siegel yield. There are 26 bonds with a yield lower and 36 with a yield higher than the Extended-Nelson-Siegel yield for the bond rated BBB+.

For the bonds from 2007 rated A there are 8 yields lower than the Extended-Nelson-Siegel model and 14 higher. There are 16 yields that are lower and 50 yields that are higher for the A- rated bonds. For the A+ rated bonds 4 are lower and 21 are higher. 6 are lower and 13 are higher for bonds rated AA. There are 9 yields that are lower and 24 that are higher for the AA-. For AA+ there are 10 lower yields and 20 higher yields. There is only one bond rated BBB- and that yield is a lot higher than the Extended-Nelson-Siegel yield. For bonds rated BBB+ there are 25 lower and 52 higher. The spread differs a lot for the different bonds for both A, A- and BBB+ rated bonds. The bonds rate A, A- and BBB+ are the bonds where the spread differentiate the most.

We have found the following mean and standard deviation for the different credit ratings:

	2004 A	2004 AA	2004 BBB
Mean	0,064	0,019	0,066
Standard deviation	0,118	0,074	0,113

	2005 A	2005 AA	2005 BBB
Mean	0,026	0,010	0,009
Standard deviation	0,076	0,046	0,066

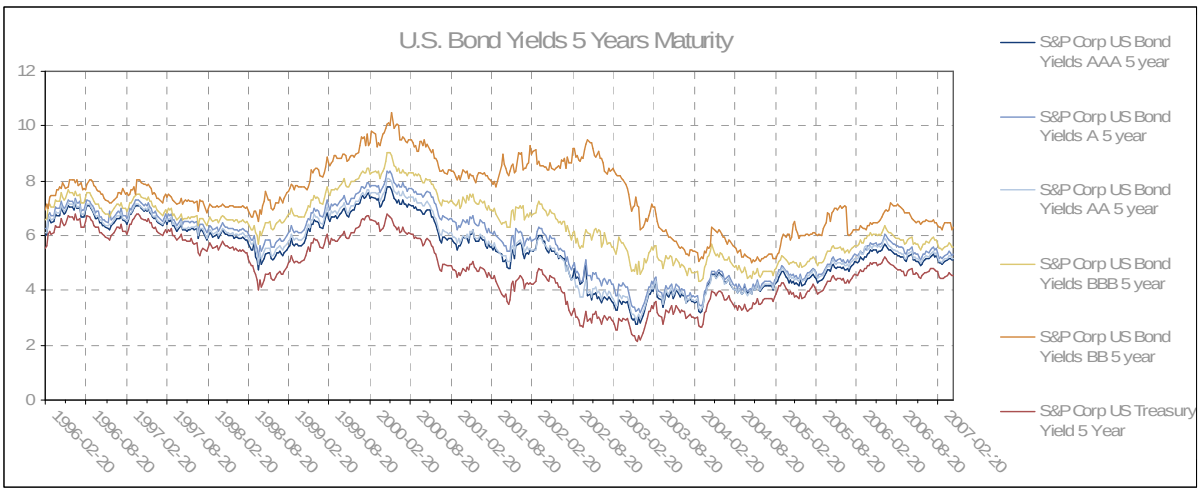
	2006 A	2006 AA	2006 BBB
Mean	0,053	0,000	0,002
Standard deviation	0,131	0,025	0,088

	2007 A	2007 AA	2007 BBB
Mean	0,036	-0,002	0,033
Standard deviation	0,106	0,035	0,118

From all the corporate bonds we have looked at there were a few companies that have had a change in rating and those are: Atlas Copco was rated A- by Standard and Poor's and was upgraded to A in 2006, Autoliv was rated BBB+ by Standard and Poor's and was upgraded to A- in 2006, Electrolux was rated BB+ by Standard and Poor's and was upgraded to BBB+ in 2006, Ericsson was rated BB+ by Standard and Poor's and was upgraded to BBB- in 2006, Fortum was rated BBB+ by Standard and Poor's and was

upgraded to A- in 2006, Jönköping kommun was rated AA- by Standard and Poor's and was upgraded to AA in 2007, Länsförsäkringar bank was rated BBB+ by Standard and Poor's and was upgraded to A- in 2006, OMX was rated A+ by Standard and Poor's and was downgraded to A in 2006, Specialfast was rated AA by Standard and Poor's and was upgraded to AA+ in 2006, Swedish Match was rated A- by Standard and Poor's and was downgraded to BBB+ in 2007 and finally Telia was rated A by Standard and Poor's and was downgraded to A- in 2005. From this we can conclude that only a few of all the companies were downgraded in rating from 2004 to 2007 and many did not change rating at all. When looking at bonds which have had a change in rating during 2004 to 2007 we couldn't see a clear connection between them. A reason to that could be that the rating changes for bonds can be delayed because of bureaucratic processes can be time consuming and that can lead to prices that are not reflecting the ratings.

Further, we have looked at other markets to see if our results for the Swedish market are reliable. We have looked at U.S. and Euro corporate bond yields. For U.S. corporate bond yields we have looked at 5, 10, 15, 20 and 25 years of maturity and compared them to the U.S. Treasuries. The rating categories we look at are: AAA, AA, A, BBB and BB. Unfortunately BB is not available for 20 years of maturity and BB and BBB are not available for 25 years of maturity. The data are from 1996 to 2007. The results are as follows:



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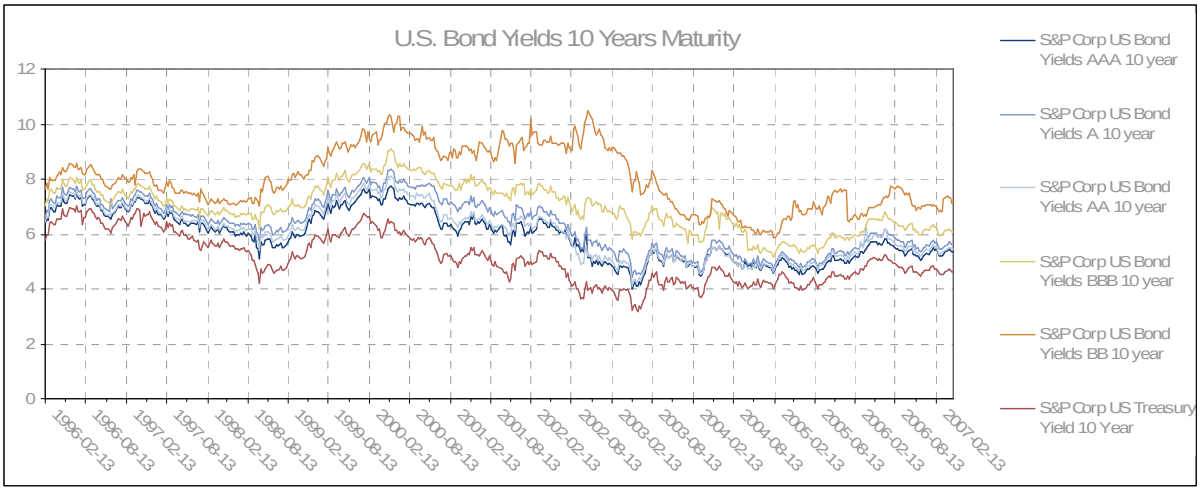
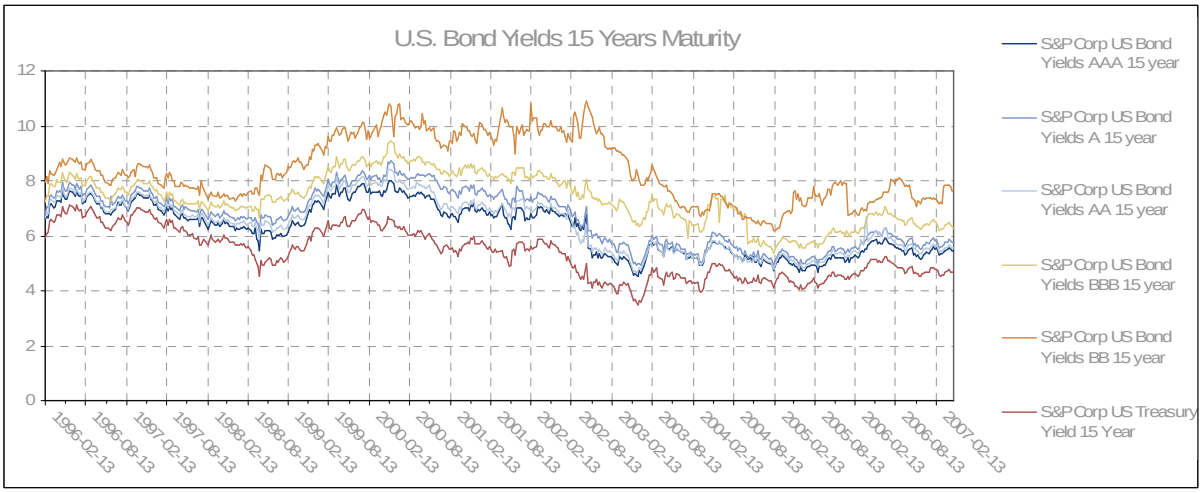


Source: Bloomberg



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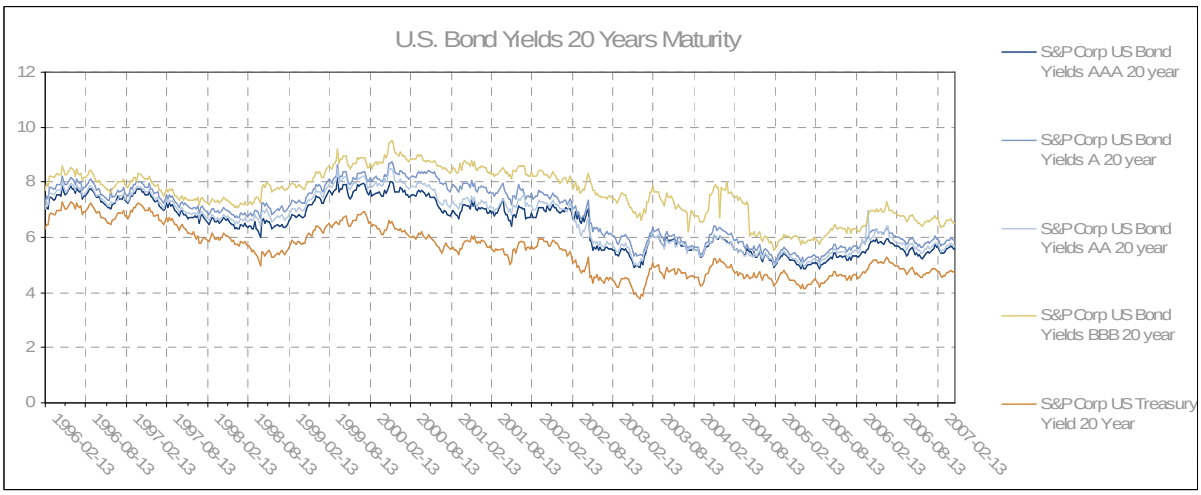
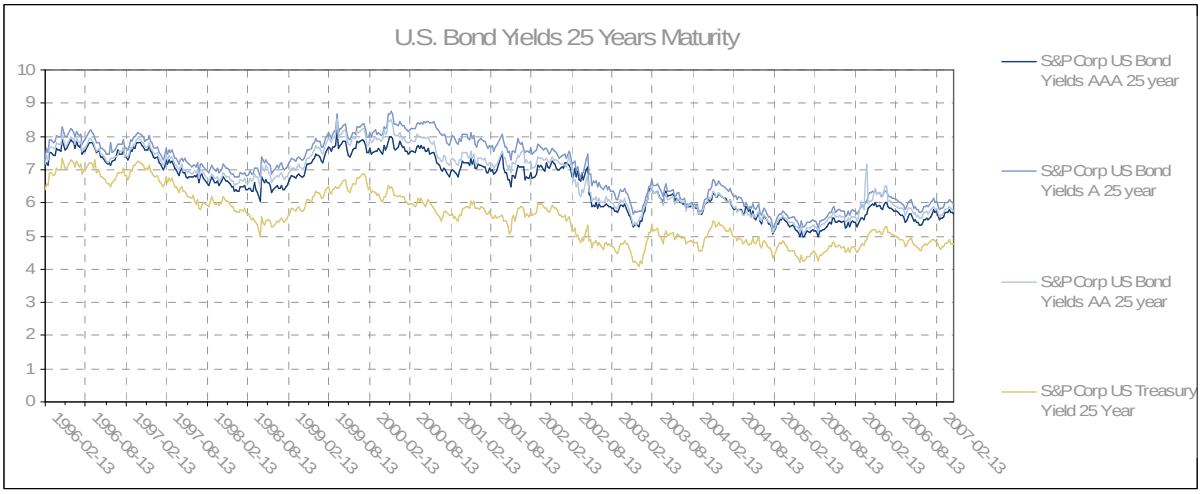
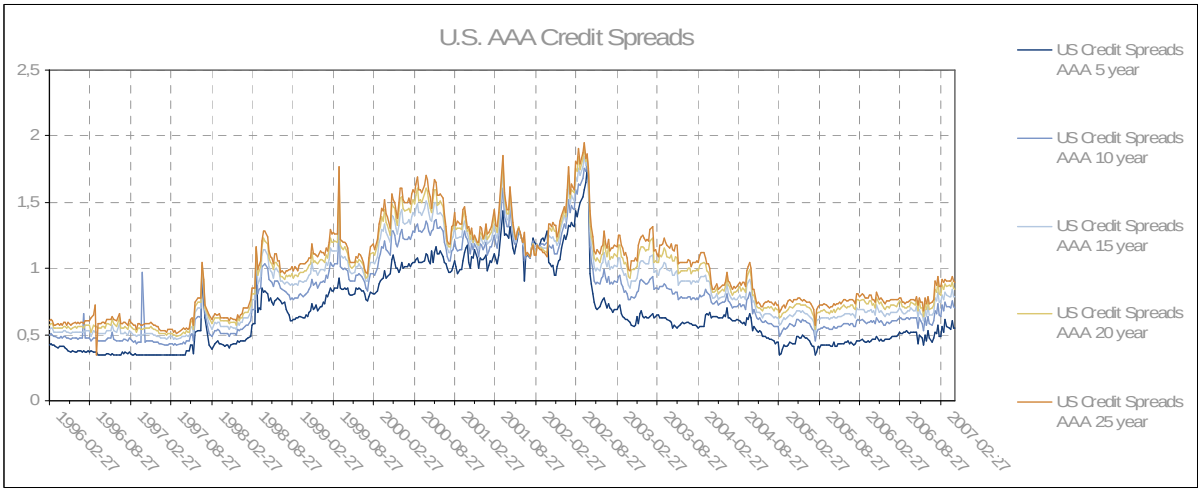


Source: Bloomberg



Source: Bloomberg

From the results we can see that the lower the rating category of the bond the higher credit spread. Further, we can see below that the longer the maturity of the bond the higher the credit spread. This is consistent with our result for the Swedish market. This you can also see more in detail below:



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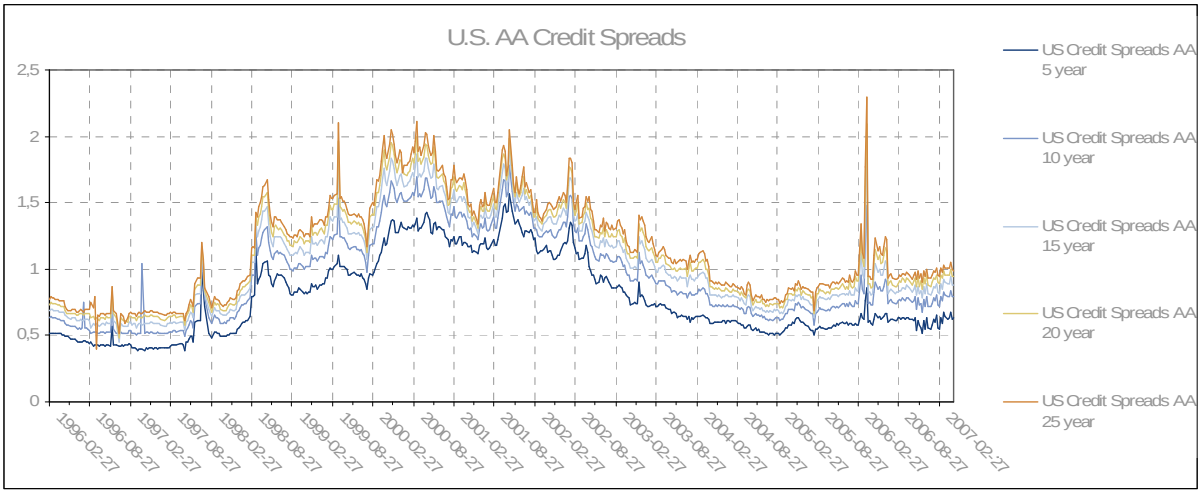

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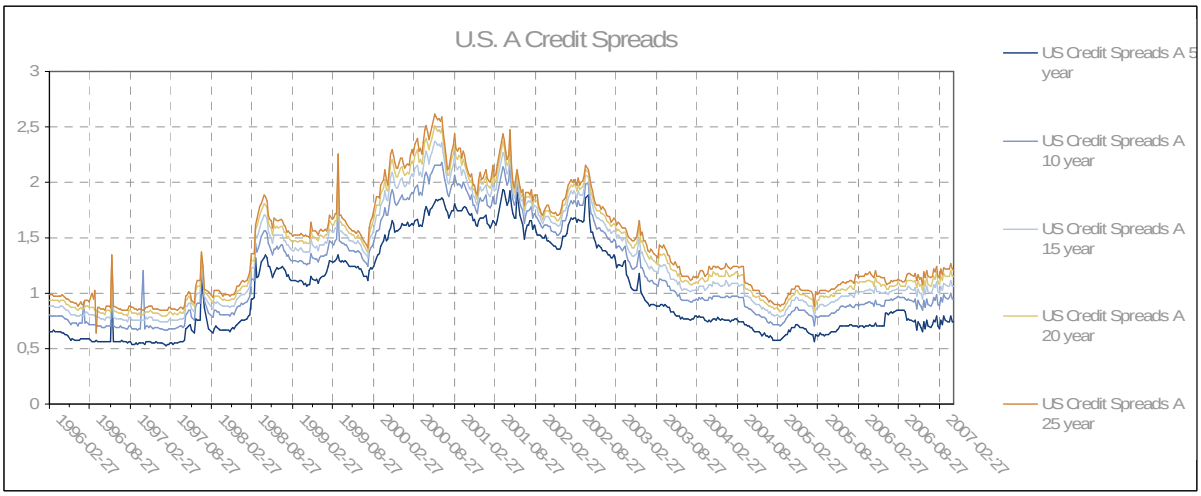

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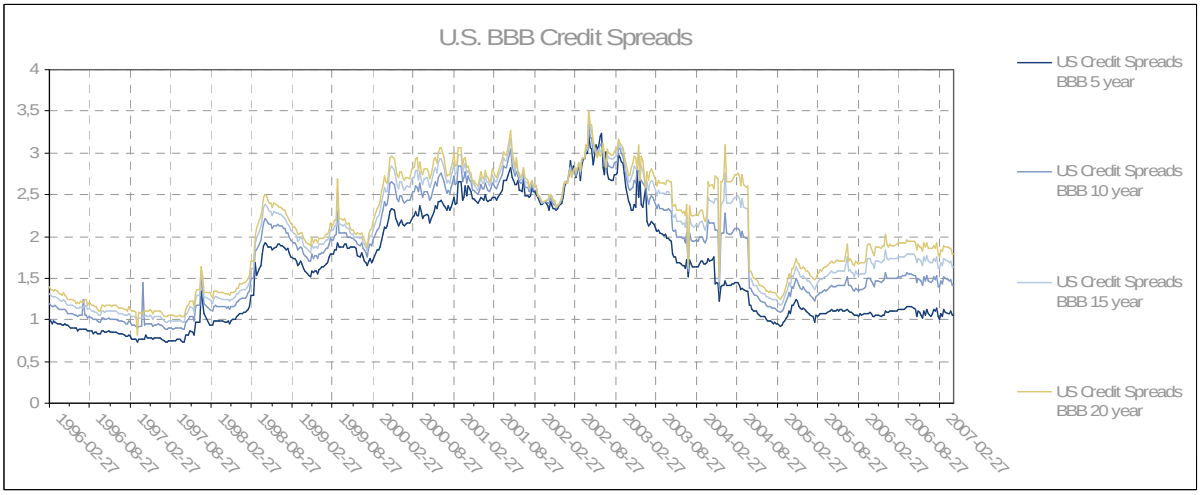
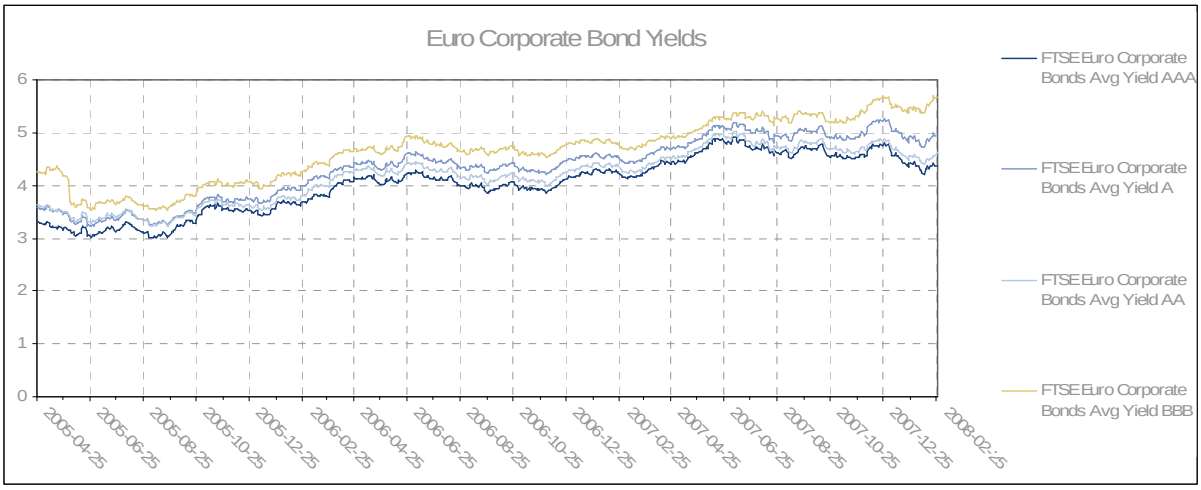


Source: Bloomberg

Moreover, we get the same results if we look at Euro corporate bond yields i.e. the lower the rating category of the bond the higher yields. This you can also see more in detail below:



Source: Bloomberg

However, we can still not say that we can use the government bond yields and add basis points to find a yield for a corporate bond with a different credit rating.

5 ANALYSIS

In this section, we will discuss and present our belief and opinions based on the reasoning from previous chapters.

5.1 Analysis of the Results

In fact whatever is the interpolated technique used we believe that the results are quite poor. Moreover, spot rates on promised payments may not be a perfect mechanism for pricing risky bonds because the law of one price will hold as an approximation when applied to promised payments rather than risk-adjusted expected payments.[37]

Our analysis has shown that we can't use the Treasury yields and add basis points to find a yield for a corporate bond with a different credit rating. We didn't get the results we assumed because the corporate bonds didn't always have a higher yield to maturity than the government bonds for the Swedish market. Perhaps one reason for that is that the yields are lower than the Extended-Nelson-Siegel yields and the bonds are not always correctly rated. A further reason to these results could also be that we haven't limited our research to bonds with maturities larger than one year. Bonds with maturities lower than one year are likely to be illiquid. The bid-ask spread and the spot spread might increase when the liquidity decrease. A decrease in the liquidity can lead to that the price of the bond doesn't reflect the market price. Prices of bonds are also dependent on how well the company performs. That can be a reason for our result.

When looking at bonds which have had a change in rating during 2004 to 2007 we couldn't see a clear connection between them. A reason to that could be that the rating changes for bonds can be delayed because of bureaucratic processes can be time consuming and that can lead to prices that are not reflecting the ratings.

However, from our analysis we have been able to conclude that the lower the rating category and the longer the maturity of the bond the higher credit spread. Further, looking at the spreads for each rating category we can see that credit spreads on plus rated bonds have significantly lower credit spreads than minus rated bonds. Hence, credit spread changes are significantly negatively correlated with changes in the credit level and the slope of the Treasuries.

[37] Elton, Gruber, Brown and Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed p. 513f

For the future it would have been interesting to study bonds in the Swedish market with the same maturity to be able to see if we could have found an average spread and see if the average spread was larger than the Extended-Nelson-Siegel. This was not possible because of the size of data wasn't an adequate amount. To be able to do that we would have needed more data sources or maybe studied the Euro market instead of the Swedish market.

6 CONCLUSION

This last chapter will bring the results to an end.

6.1 Conclusion

From our analysis we have been able to conclude that the lower the rating category and the longer the maturity of the bond the higher credit spread. Further, looking at the spreads for each rating category we can see that credit spreads on plus rated bonds have significantly lower credit spreads than minus rated bonds. Hence, credit spread changes are significantly negatively correlated with changes in the credit level and the slope of the default-free government bonds.

7 REFERENCE LIST

Lastly we will present a list of references.

7.1 Literature

Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann © 2007 Modern portfolio theory and investment analysis 7th ed
Available: http://eu.wiley.com

Zvi Bodie, Alex Kane, Alan J. Marcus © 2007 Essentials of investments 6th
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Hull, John © 2003, Options, Futures, and Other Derivatives
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Moody's Investors Service: Creditworthiness ratings
Available: http://www.moodys.com

Fitch Ratings: Creditworthiness ratings
Available: http://www.fitchratings.com/

Standard and Poor's a division of The McGraw-Hill Companies: Creditworthiness ratings
Available: http://www2.standardandpoors.com

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A. Landschoot © 2003 The term structure of credit spreads on euro corporate bonds
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Available: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=302700

8 DEFINITIONS

Lastly we will present the most important definitions used in the paper.

Accrued Interest

The interest earned since the last coupon payment. However, the owner of the bond has not officially received the money since the bond has not yet expired. If the bond is sold the accrued interest will be added to the price of the contract.

Maturity

The maturity of the bond tells you when you should expect to get your principal back and for
how long you can expect to receive interest payments.

Bond

A bond is a debt security and is issued for a period of more than one year. When you buy a bond you lend money and the seller of the bond promises to repay the principal amount at a specific time in the future.

Bond rating

When you hear about a rating for a bond it is the probability of default by the bond issuer. The ratings range from investment grade (highly rated bonds) to speculative grade and finally default grade.

Bootstrapping

Bootstrapping is when you create a theoretical spot rate curve using one yield projection as the basis for the yield of the next maturity.

Clean price

Is the bond price before accrued interest is added (see also dirty price)

Callable

When a bond has call features it is a bond that can be redeemed by the issuer of the bond before maturity of the bond. A bond is usually called back when interest rates fall radically. In that case the issuer can save more money by issuing new bonds at lower rates.

Current yield

The current yield can often be seen in newspapers and is the coupon rate divided by the market price of the bond.

Default

Default is the failure or unwillingness of a company to make timely payment of interest or principal on a debt security.

Default risk

The default risk is the company's ability to earn money and meet the obligations of the debt issue. Default risk is also known as credit risk.

Dirty price

The dirty price is the bond's price including accrued interest. It is the actual price paid by the investor of a bond.

Duration

Is the price sensitivity of a fixed income instrument due to a change in interest rates.

Flat

Flat is referred to in the text when a bond does not have a plus neither a negative grade.

Floating Rate Note (FRN)

Bonds with variable interest rates that are adjusted periodically according to a specific market rate.

Forward rate

Is a prediction of future interest rates calculated from either the yield curve or spot rates.

Forward rate agreement (FRA)

Is an agreement to lend or borrow at an specific interest rate that is fixed today and at a specific future date.

Government securities
Is Treasury securities.

High-grade bond
A bond with high investment grade rating i.e. AAA by one of the major credit rating agencies.

Interest
The price paid for borrowing money or the price to be paid for lending money.

Maturity date
The date at which the bond finishes and the date when the principal amount becomes due and payable.

Over-the-counter (OTC)
A decentralized market where dealers are linked by telephones and computer screens.

Par value
Is a price equal to the nominal or face value of the security. It's the amount that an issuer agrees to pay the investor at maturity

Settlement
When the payment is made for a trade.

Settlement date
A date when payment is made to settle a trade.

Spot rate
The yields to maturity on loans or bonds that pay only one cash flow i.e. a zero-coupon bond.

Spot rate curve

The graphical depiction of the relationship between the spot rates and maturity.

Spread

The difference between bid and ask prices of a bond or other security.

Systematic risk

The risk related to the market also called undiversifiable risk.

Yield curve

The graphic depiction of the relationship between the yield on bonds of the same credit quality but different maturities.

Yield

The effective rate of interest paid on a bond or note.

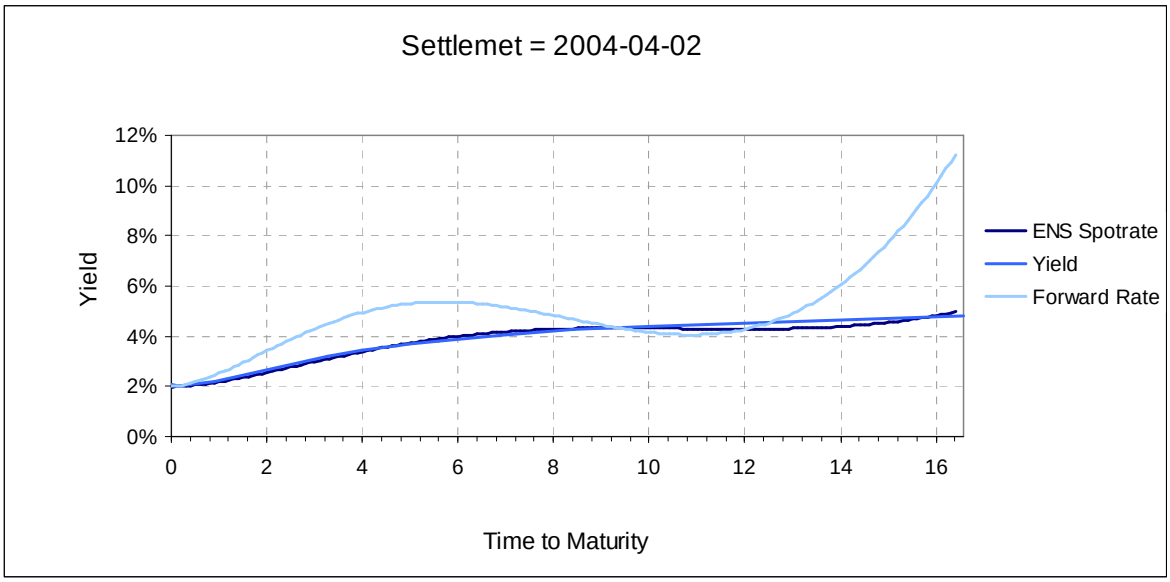
Yield to maturity

The calculation of yield to maturity is based on the coupon rate, time to maturity and the market price of the security. It is the percentage rate of return paid on a bond or other fixed income security if the investor buys and holds it to its maturity date. Basically, the yield to maturity assumes that the coupon interest paid over the life of the security will be reinvested at the same rate.

Zero-coupon bond

Both principal and interest is paid at maturity and no periodic coupon is paid over the life of the bond.

APPENDIX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4%
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Yield
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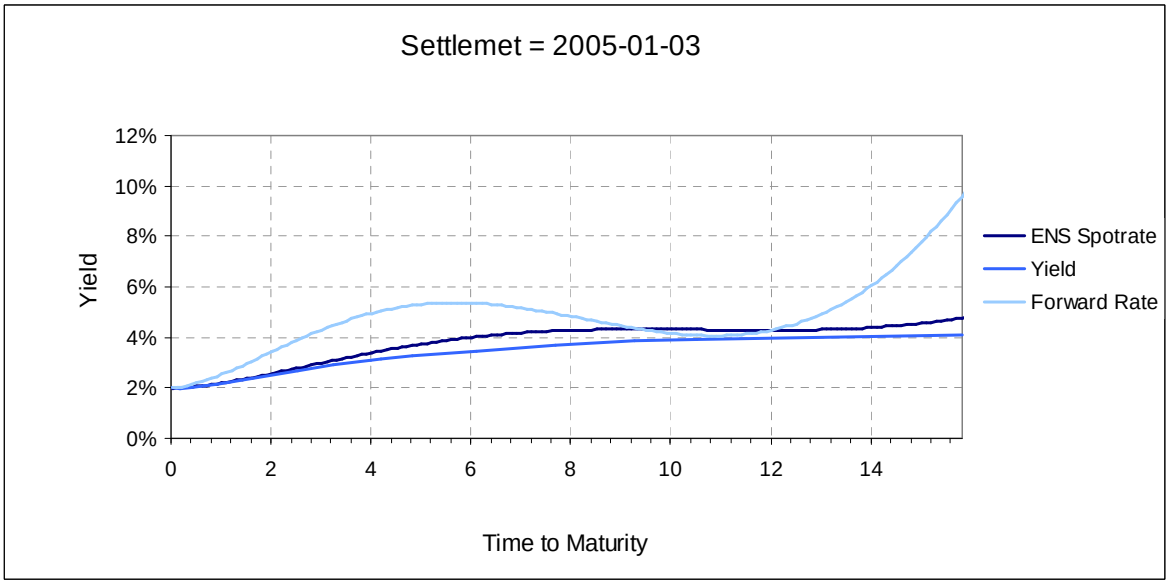
2
4
6
8
10
12
14
16
Time to Maturity
ENS Spotrate
Yield
Forward Rate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Yield
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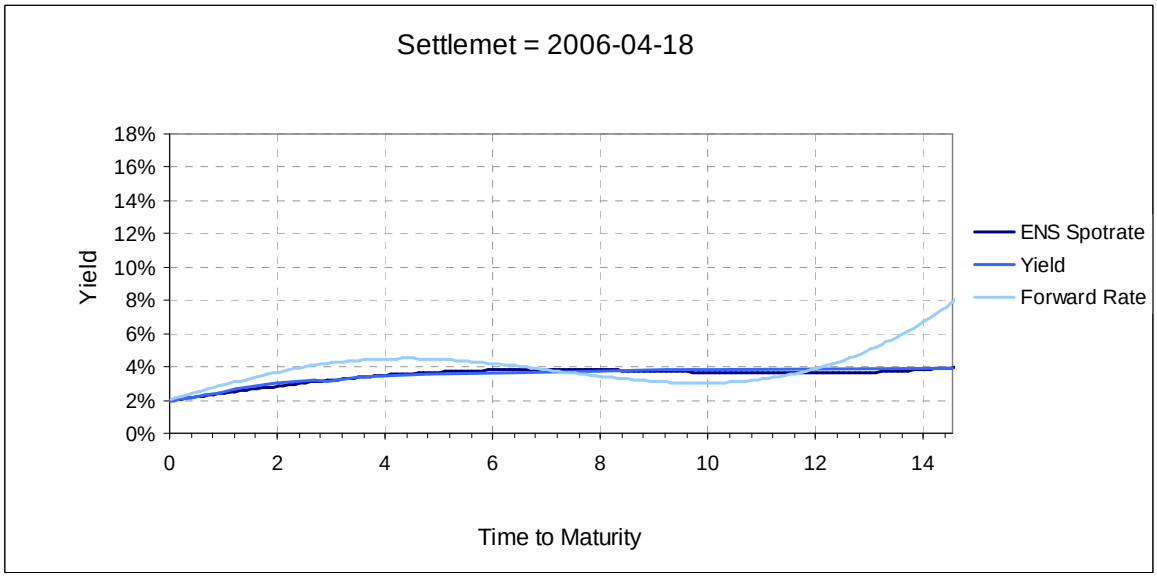
Time to Maturity
ENS Spotrate
Yield
Forward Rate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8
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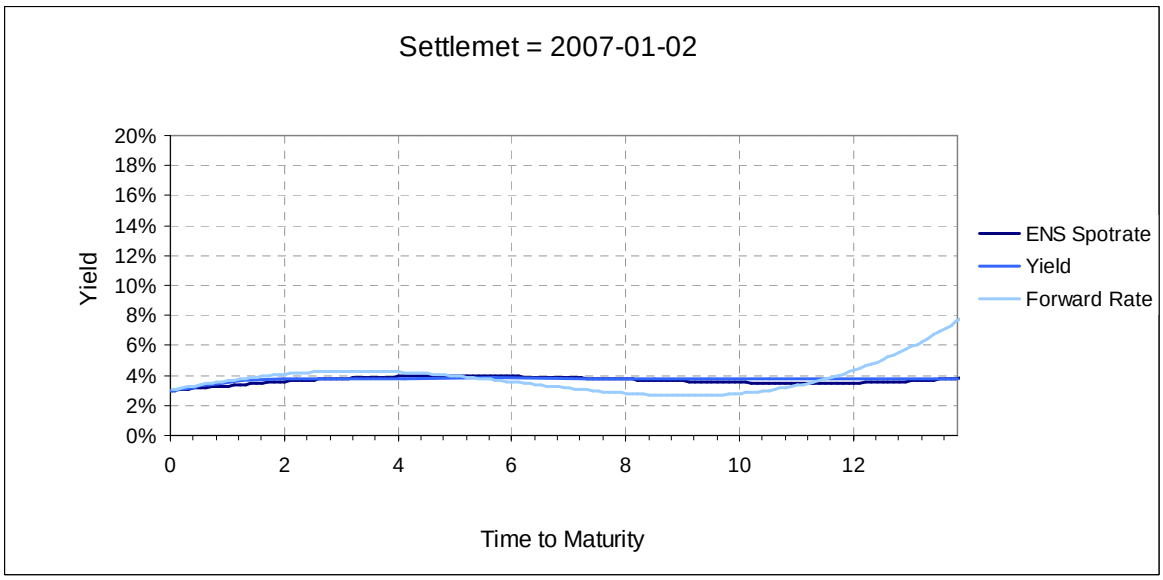
14
Time to Maturity
ENS Spotrate
Yield
Forward Rate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18%
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14%
12%
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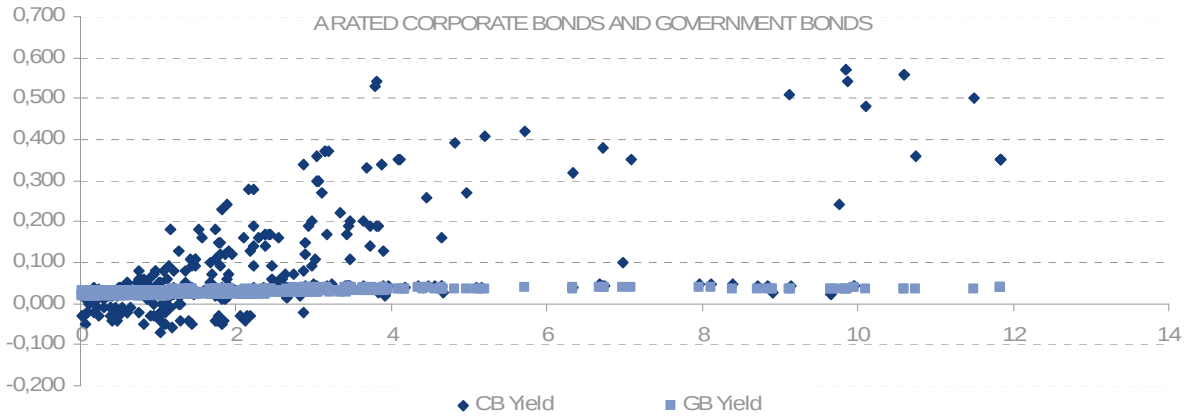
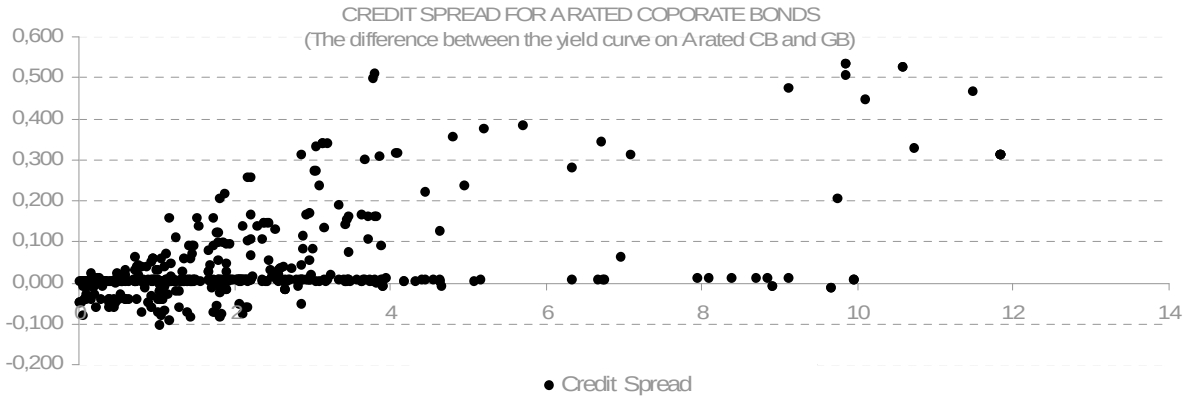
6%
4%
2%
0%
Yield
0
2
4
6
8
10
12
Time to Maturity
ENS Spotrate
Yield
Forward Rate

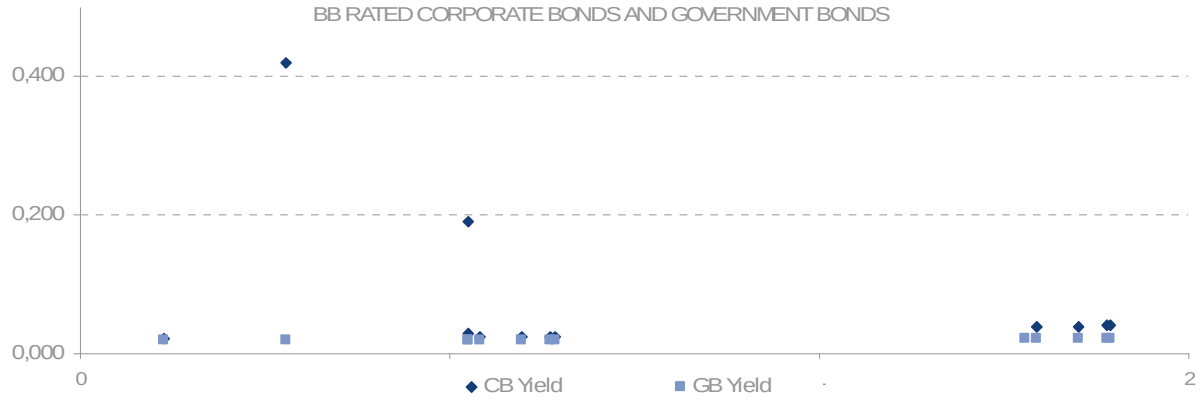
In this part we have illustrated A, AA, BBB and BB rated corporate bonds yields against the yields for government bonds with the same settlement date but with different maturities (X – axis). Plus rated, negative rated as well as neutral rated bonds have been put together. This means that the A rated includes A, A- and A+ bonds. We have also illustrated the credit spreads for A, AA, BB and BBB rated corporate bonds.

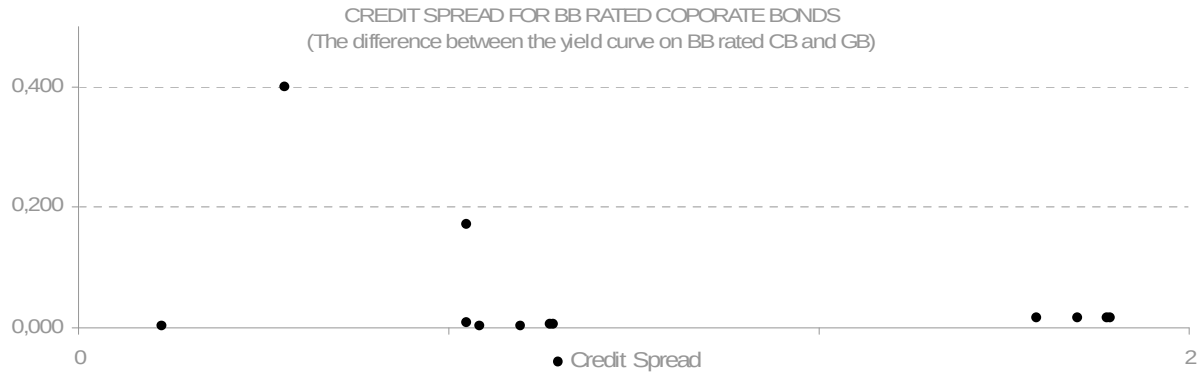
A Rated Corporate Bonds





BB Rated Corporate Bonds





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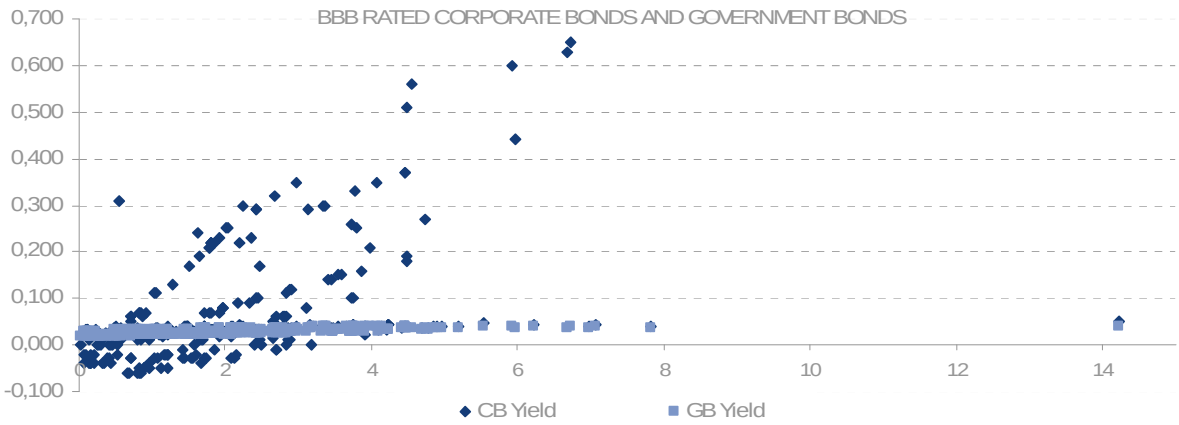
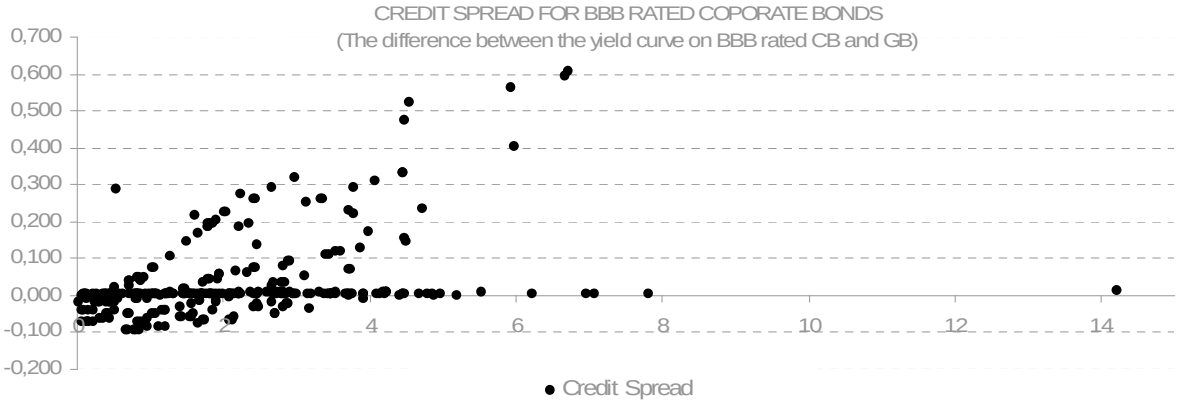
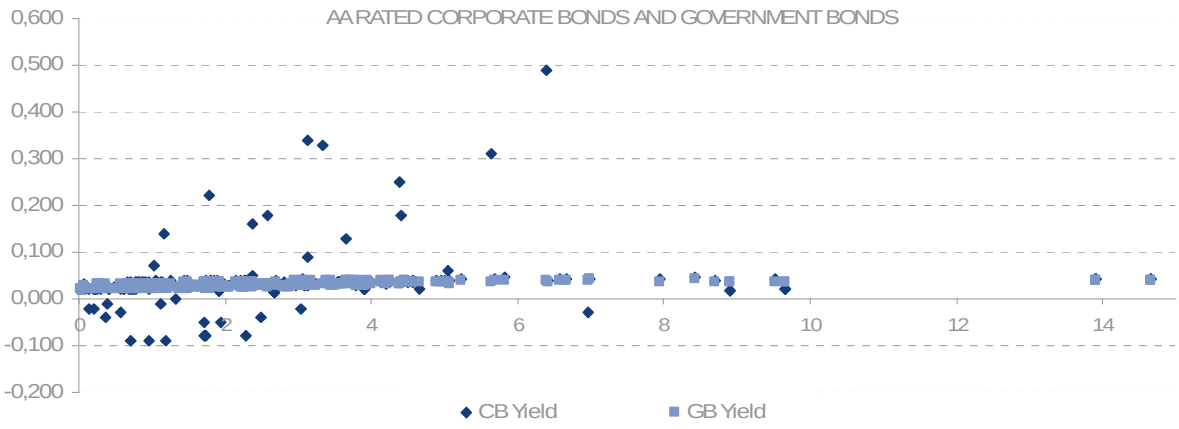
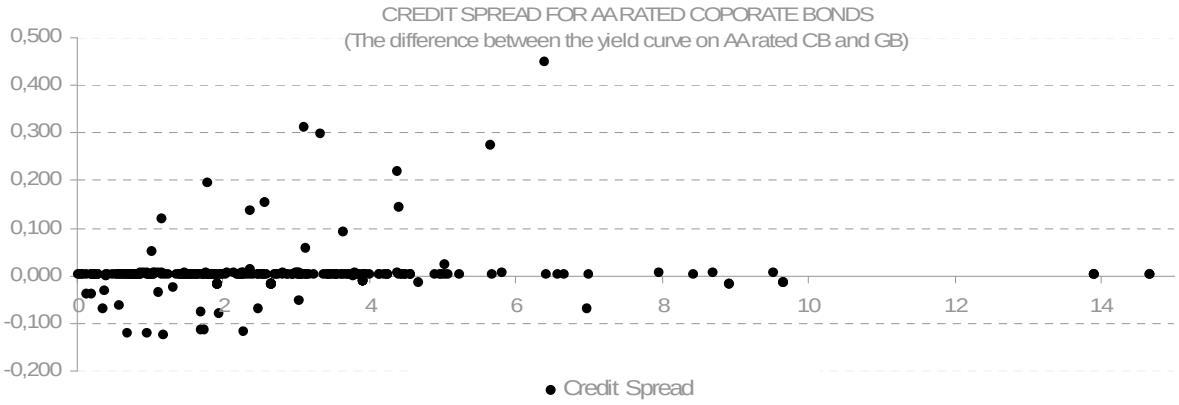




AA Rated Corporate Bonds





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name: AKADEMISKA 117, product: CPI, rating: AA	name: LF BANK 144, product: FIX, rating: A-
name: AKADEMISKA 118, product: CPI, rating: AA	name: LF BANK 145, product: FIX, rating: A-
name: AKADEMISKA 120, product: BULLET, rating: AA	name: LF BANK 146, product: FRN, rating: A-
name: AKADEMISKA 121, product: BULLET, rating: AA	name: LF BANK 147, product: FRN, rating: A-
name: AKADEMISKA 122, product: BULLET, rating: AA	name: LF BANK 148, product: FRN, rating: A-
name: AKADEMISKA 123, product: FIX, rating: AA	name: LF BANK 149, product: FIX, rating: A-
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name: AKADEMISKA 126, product: FIX, rating: AA	name: OMX 5, product: FRN, rating: A
name: AKADEMISKA 127, product: FIX, rating: AA	name: OMX 6, product: FRN, rating: A
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name: Assa Abloy 4, product: FRN, rating: A-	name: SANDVIK 106, product: FIX, rating: A+
name: ATLAS 101, product: BULLET, rating: A-	name: SANDVIK 107, product: FRN, rating: A+
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name: AUTOLIV 102, product: BULLET, rating: BBB+	name: SCANIA 127, product: FRN, rating: A-
name: AUTOLIV 104, product: BULLET, rating: BBB+	name: SCANIA 13, product: FRN, rating: A-
name: AUTOLIV 105, product: BULLET, rating: BBB+	name: SCANIA 132, product: FRN, rating: A-
name: AUTOLIV 106, product: FRN, rating: BBB+	name: SCANIA 135, product: FRN, rating: A-
name: AUTOLIV 107, product: FRN, rating: BBB+	name: SCANIA 14, product: FRN, rating: A-
name: AUTOLIV 108, product: BULLET, rating: BBB+	name: SCANIA 140, product: FRN, rating: A-
name: AUTOLIV 109, product: BULLET, rating: BBB+	name: SCANIA 142, product: FRN, rating: A-
name: AUTOLIV 110, product: BULLET, rating: BBB+	name: SCANIA 147, product: FRN, rating: A-
name: AUTOLIV 111, product: FIX, rating: A-	name: SCANIA 148, product: FRN, rating: A-
name: AUTOLIV 112, product: FIX, rating: A-	name: SCANIA 149, product: FRN, rating: A-
name: ELECTROLUX 14, product: CPI, rating: BBB+	name: SCANIA 15, product: FRN, rating: A-
name: ELECTROLUX 16, product: BULLET, rating: BBB+	name: SCANIA 150, product: BULLET, rating: A-
name: ELECTROLUX 17, product: FIX, rating: BBB+	name: SCANIA 151, product: FRN, rating: A-
name: ELECTROLUX 18, product: FIX, rating: BBB+	name: SCANIA 152, product: FRN, rating: A-
name: ELECTROLUX 19, product: FRN, rating: BBB+	name: SCANIA 153, product: BULLET, rating: A-
name: ELECTROLUX 20, product: FRN, rating: BBB+	name: SCANIA 154, product: BULLET, rating: A-
name: EON Sverige 148, product: FIX, rating: A	name: SCANIA 155, product: BULLET, rating: A-
name: EON Sverige 149, product: FRN, rating: A	name: SCANIA 156, product: FRN, rating: A-
name: EON Sverige 150, product: FRN, rating: A	name: SCANIA 157, product: FRN, rating: A-
name: EON Sverige 151, product: FIX, rating: A	name: SCANIA 158, product: BULLET, rating: A-
name: EON Sverige 152, product: FRN, rating: A	name: SCANIA 159, product: FIX, rating: A-
name: EON Sverige 153, product: FRN, rating: A	name: SCANIA 160, product: FIX, rating: A-
name: EON Sverige 154, product: FRN, rating: A	name: SCANIA 22, product: FRN, rating: A-
name: ERICSSON 07/05, product: FRN, rating: BB+	name: SCANIA 23, product: FRN, rating: A-
name: ERICSSON 08/05, product: BULLET, rating: BB+	name: SCANIA 24, product: FRN, rating: A-
name: ERICSSON 10/04, product: BULLET, rating: BB+	name: SCANIA 32, product: BULLET, rating: A-
name: ERICSSON 12/12, product: FRN, rating: BB+	name: SCANIA 33, product: BULLET, rating: A-
name: ERICSSON 16, product: FRN, rating: BB+	name: SCANIA 8, product: FRN, rating: A-
name: ERICSSON 19, product: BULLET, rating: BB+	name: SCANIA 9, product: FRN, rating: A-

name: ERICSSON 21, product: BULLET, rating: BB+	name: SEB 01/08, product: FRN, rating: A
name: ERICSSON 6.9 05, product: FIX, rating: BB+	name: SEB 134, product: FRN, rating: A
name: ERICSSON FRN 07/05, product: FRN, rating: BB+	name: SEB 138, product: CPI, rating: A
name: FORTUM 101, product: FRN, rating: BBB+	name: SEB 149, product: FRN, rating: A
name: INDUSTRIV 109, product: FRN, rating: A+	name: SEB 153, product: FIX, rating: A
name: INDUSTRIV 110, product: FRN, rating: A+	name: SEB 161, product: FRN, rating: A
name: INDUSTRIV 119, product: FRN, rating: A+	name: SEB 167, product: FRN, rating: A
name: INDUSTRIV 121, product: BULLET, rating: A+	name: SEB 170, product: FRN, rating: A
name: INDUSTRIV 123, product: BULLET, rating: A+	name: SEB 175, product: FRN, rating: A
name: INDUSTRIV 124, product: FRN, rating: A+	name: SEB 176, product: FRN, rating: A
name: INDUSTRIV 125, product: CPI, rating: A+	name: SEB 178, product: FRN, rating: A
name: INDUSTRIV 126, product: BULLET, rating: A+	name: SEB 215, product: FRN, rating: A
name: INDUSTRIV 127, product: BULLET, rating: A+	name: SEB 335, product: FRN, rating: A
name: INDUSTRIV 128, product: BULLET, rating: A+	name: SKANDIA AB FL 7.82 17, product: BULLET, rating: A
name: INDUSTRIV 129, product: BULLET, rating: A+	name: SKANDIA AB FL1, product: BULLET, rating: A
name: INDUSTRIV 130, product: FIX, rating: A+	name: SKANDIACAP 05/05, product: FIX, rating: A
name: INDUSTRIV 131, product: FIX, rating: A+	name: SKANDIACAP 07/06, product: FRN, rating: A
name: INDUSTRIV 132, product: FIX, rating: A+	name: SKANDIACAP 09/06, product: FRN, rating: A
name: INDUSTRIV 133, product: FIX, rating: A+	name: SKANDIACAP 28, product: FRN, rating: A
name: INDUSTRIV 134, product: FIX, rating: A+	name: SKANDIACAP 4 10, product: FIX, rating: A
name: INDUSTRIV 135, product: FRN, rating: A+	name: SKANDIACAP 5.5 06, product: FIX, rating: A
name: INDUSTRIV 136, product: FRN, rating: A+	name: SKANDIACAP 5E, product: FRN, rating: A
name: INDUSTRIV 137, product: FRN, rating: A+	name: SKANDIACAP 6, product: FIX, rating: A
name: INDUSTRIV 138, product: FRN, rating: A+	name: SPECIALFAST 101, product: FRN, rating: AA
name: INDUSTRIV 139, product: FIX, rating: A+	name: SPECIALFAST 106, product: BULLET, rating: AA
name: INDUSTRIV 140, product: FIX, rating: A+	name: SPECIALFAST 111, product: BULLET, rating: AA
name: INDUSTRIV 141, product: FIX, rating: A+	name: SPECIALFAST 112, product: BULLET, rating: AA
name: INDUSTRIV 142, product: FIX, rating: A+	name: SPECIALFAST 114, product: BULLET, rating: AA
name: INDUSTRIV 143, product: FIX, rating: A+	name: SPECIALFAST 117, product: BULLET, rating: AA
name: INDUSTRIV 144, product: FIX, rating: A+	name: SPECIALFAST 118, product: BULLET, rating: AA
name: INDUSTRIV 145, product: FIX, rating: A+	name: SPECIALFAST 119, product: BULLET, rating: AA
name: INDUSTRIV 146, product: FRN, rating: A+	name: SPECIALFAST 120, product: FRN, rating: AA
name: INDUSTRIV 6, product: FRN, rating: A+	name: SPECIALFAST 121, product: BULLET, rating: AA
name: INDUSTRIV 7, product: FIX, rating: A+	name: SPECIALFAST 122, product: FRN, rating: AA
name: INVESTOR 104, product: FRN, rating: AA-	name: SPECIALFAST 123, product: CPILINKED, rating: AA
name: INVESTOR 105, product: BULLET, rating: AA-	name: SPECIALFAST 124, product: BULLET, rating: AA
name: INVESTOR 107, product: CPI, rating: AA-	name: SPECIALFAST 125, product: FRN, rating: AA
name: INVESTOR 108, product: CPI, rating: AA-	name: SPECIALFAST 126, product: BULLET, rating: AA
name: INVESTOR 109, product: CPI, rating: AA-	name: SPECIALFAST 127, product: BULLET, rating: AA
name: INVESTOR 110, product: BULLET, rating: AA-	name: SPECIALFAST 128, product: BULLET, rating: AA
name: INVESTOR 111, product: CPI, rating: AA-	name: SPECIALFAST 129, product: CPI, rating: AA+
name: INVESTOR 112, product: BULLET, rating: AA-	name: SPECIALFAST 130, product: FIX, rating: AA+
name: INVESTOR 115, product: BULLET, rating: AA-	name: SPECIALFAST 131, product: FIX, rating: AA+
name: INVESTOR 116, product: FRN, rating: AA-	name: SPECIALFAST 132, product: FIX, rating: AA+
name: INVESTOR 117, product: BULLET, rating: AA-	name: SSAB 106, product: FRN, rating: BBB+
name: INVESTOR 118, product: BULLET, rating: AA-	name: SSAB 107, product: BULLET, rating: BBB+
name: INVESTOR 119, product: FRN, rating: AA-	name: SSAB 108, product: BULLET, rating: BBB+
name: INVESTOR 120, product: BULLET, rating: AA-	name: SSAB 109, product: BULLET, rating: BBB+
name: INVESTOR 121, product: BULLET, rating: AA-	name: SSAB 111, product: BULLET, rating: BBB+
name: INVESTOR 122, product: BULLET, rating: AA-	name: SSAB 112, product: BULLET, rating: BBB+
name: INVESTOR 123, product: FRN, rating: AA-	name: SSAB 113, product: BULLET, rating: BBB+

name: INVESTOR 124, product: FRN, rating: AA-	name: SSAB 114, product: BULLET, rating: BBB+
name: INVESTOR 125, product: FRN, rating: AA-	name: SSAB 115, product: FRN, rating: BBB+
name: INVESTOR 126, product: FIX, rating: AA-	name: SSAB 116, product: FRN, rating: BBB+
name: INVESTOR 25, product: BULLET, rating: AA-	name: SSAB 117, product: BULLET, rating: BBB+
name: INVESTOR 4 2008, product: CPI, rating: AA-	name: SSAB 118, product: BULLET, rating: BBB+
name: JÖNKÖP KN 1, product: BULLET, rating: AA-	name: SSAB 119, product: BULLET, rating: BBB+
name: JÖNKÖP KN 2, product: BULLET, rating: AA-	name: SSAB 120, product: BULLET, rating: BBB+
name: JÖNKÖP KN 1, product: FIX, rating: AA-	name: STHLM STAD 100, product: BULLET, rating: AA+
name: JÖNKÖP KN 2, product: FIX, rating: AA-	name: STHLM STAD 109, product: BULLET, rating: AA+
name: JÖNKÖP KN 3, product: FIX, rating: AA-	name: STHLM STAD 124, product: BULLET, rating: AA+
name: JÖNKÖP KN 4, product: FIX, rating: AA-	name: STHLM STAD 132, product: BULLET, rating: AA+
name: JÖNKÖP KN 5, product: FIX, rating: AA-	name: STHLM STAD 150, product: FRN, rating: AA+
name: JÖNKÖP KN 6, product: FIX, rating: AA	name: STHLM STAD 151, product: FIX, rating: AA+
name: JÖNKÖP KN 7, product: FIX, rating: AA	name: STHLM STAD 152, product: FIX, rating: AA+
name: LANDSHYP 114, product: BULLET, rating: BBB+	name: STHLM STAD 153, product: FIX, rating: AA+
name: LANDSHYP 115, product: BULLET, rating: BBB+	name: STHLM STAD 155, product: FRN, rating: AA+
name: LANDSHYP 127, product: FRN, rating: BBB+	name: STHLM STAD 156, product: FRN, rating: AA+
name: LANDSHYP 129, product: FRN, rating: BBB+	name: STHLM STAD 157, product: FRN, rating: AA+
name: LANDSHYP 132, product: BULLET, rating: BBB+	name: STHLM STAD 158, product: FIX, rating: AA+
name: LANDSHYP 133, product: FRN, rating: BBB+	name: STHLM STAD 159, product: FIX, rating: AA+
name: LANDSHYP 134, product: BULLET, rating: BBB+	name: STHLM STAD 160, product: FIX, rating: AA+
name: LANDSHYP 135, product: BULLET, rating: BBB+	name: STHLM STAD 161, product: FRN, rating: AA+
name: LANDSHYP 139, product: FRN, rating: BBB+	name: STHLM STAD 162, product: FIX, rating: AA+
name: LANDSHYP 141, product: FRN, rating: BBB+	name: STHLM STAD 163, product: FIX, rating: AA+
name: LANDSHYP 145, product: FRN, rating: BBB+	name: STHLM STAD 23, product: FIX, rating: AA+
name: LANDSHYP 146, product: FRN, rating: BBB+	name: STHLM STAD E132, product: FIX, rating: AA+
name: LANDSHYP 147, product: FRN, rating: BBB+	name: SUNDSV KN 1001, product: BULLET, rating: AA-
name: LANDSHYP 148, product: FRN, rating: BBB+	name: SUNDSV KN 1002, product: FIX, rating: AA-
name: LANDSHYP 150, product: FRN, rating: BBB+	name: SUNDSV KN 150, product: BULLET, rating: AA-
name: LANDSHYP 151, product: FRN, rating: BBB+	name: SUNDSV KN 151, product: BULLET, rating: AA-
name: LANDSHYP 153, product: FRN, rating: BBB+	name: SUNDSV KN 152, product: FIX, rating: AA-
name: LANDSHYP 155, product: FRN, rating: BBB+	name: SUNDSV KN 155, product: FIX, rating: AA-
name: LANDSHYP 156, product: FRN, rating: BBB+	name: SUNDSV KN 160, product: FIX, rating: AA-
name: LANDSHYP 157, product: FRN, rating: BBB+	name: SUNDSV KN 161, product: FIX, rating: AA-
name: LANDSHYP 158, product: BULLET, rating: BBB+	name: SUNDSV KN 162, product: FIX, rating: AA-
name: LANDSHYP 159, product: FRN, rating: BBB+	name: SUNDSV KN 164, product: FRN, rating: AA-
name: LANDSHYP 160, product: FRN, rating: BBB+	name: SUNDSV KN 22, product: BULLET, rating: AA-
name: LANDSHYP 161, product: BULLET, rating: BBB+	name: SUNDSV KN 23, product: BULLET, rating: AA-
name: LANDSHYP 162, product: BULLET, rating: BBB+	name: SUNDSV KN 24, product: BULLET, rating: AA-
name: LANDSHYP 163, product: FRN, rating: BBB+	name: SUNDSV KN 27, product: BULLET, rating: AA-
name: LANDSHYP 164, product: FRN, rating: BBB+	name: SUNDSV KN 30, product: BULLET, rating: AA-
name: LANDSHYP 165, product: BULLET, rating: BBB+	name: SUNDSV KN 32, product: BULLET, rating: AA-
name: LANDSHYP 166, product: BULLET, rating: BBB+	name: SUNDSV KN 33, product: BULLET, rating: AA-
name: LANDSHYP 167, product: FRN, rating: BBB+	name: SUNDSV KN 34, product: BULLET, rating: AA-
name: LANDSHYP 168, product: BULLET, rating: BBB+	name: SUNDSV KN 35, product: BULLET, rating: AA-
name: LANDSHYP 169, product: FRN, rating: BBB+	name: SUNDSV KN 36, product: BULLET, rating: AA-
name: LANDSHYP 170, product: BULLET, rating: BBB+	name: SUNDSV KN 37, product: BULLET, rating: AA-
name: LANDSHYP 171, product: BULLET, rating: BBB+	name: SUNDSV KN 38, product: BULLET, rating: AA-
name: LANDSHYP 172, product: FRN, rating: BBB+	name: SUNDSV KN 39, product: BULLET, rating: AA-
name: LANDSHYP 173, product: FRN, rating: BBB+	name: SUNDSV KN 40, product: BULLET, rating: AA-
name: LANDSHYP 174, product: FRN, rating: BBB+	name: SUNDSV KN 41, product: BULLET, rating: AA-

name: LANDSHYP 175, product: FRN, rating: BBB+	name: SUNDSV KN 42, product: BULLET, rating: AA-
name: LANDSHYP 176, product: FRN, rating: BBB+	name: SUNDSV KN 43, product: BULLET, rating: AA-
name: LANDSHYP 177, product: FRN, rating: BBB+	name: SUNDSV KN 44, product: BULLET, rating: AA-
name: LANDSHYP 178, product: FRN, rating: BBB+	name: SUNDSV KN 45, product: BULLET, rating: AA-
name: LANDSHYP 179, product: FRN, rating: BBB+	name: SUNDSV KN 46, product: BULLET, rating: AA-
name: LANDSHYP 180, product: BULLET, rating: BBB+	name: SUNDSV KN 47, product: BULLET, rating: AA-
name: LANDSHYP 181, product: BULLET, rating: BBB+	name: SUNDSV KN 48, product: BULLET, rating: AA-
name: LANDSHYP 182, product: BULLET, rating: BBB+	name: SUNDSV KN 49, product: BULLET, rating: AA-
name: LANDSHYP 183, product: FRN, rating: BBB+	name: SW MATCH 10/10, product: FRN, rating: BBB+
name: LANDSHYP 184, product: FRN, rating: BBB+	name: SW MATCH 122, product: BULLET, rating: A-
name: LANDSHYP 186, product: FRN, rating: BBB+	name: SW MATCH 125, product: FRN, rating: A-
name: LANDSHYP 187, product: FRN, rating: BBB+	name: SW MATCH 126, product: CPILINKED, rating: A-
name: LANDSHYP 188, product: FRN, rating: BBB+	name: SW MATCH 127, product: FRN, rating: A-
name: LANDSHYP 189, product: BULLET, rating: BBB+	name: SW MATCH 129, product: FRN, rating: A-
name: LANDSHYP 190, product: FIX, rating: BBB+	name: SW MATCH 13, product: FIX, rating: BBB+
name: LANDSHYP 191, product: FRN, rating: BBB+	name: SW MATCH 130, product: BULLET, rating: A-
name: LANDSHYP 192, product: FIX, rating: BBB+	name: SW MATCH 131, product: BULLET, rating: A-
name: LANDSHYP 193, product: FRN, rating: BBB+	name: SW MATCH 132, product: FRN, rating: A-
name: LANDSHYP 194, product: FRN, rating: BBB+	name: SW MATCH 133, product: BULLET, rating: A-
name: LANDSHYP 195, product: FIX, rating: BBB+	name: SW MATCH 134, product: FRN, rating: A-
name: LANDSHYP 196, product: FIX, rating: BBB+	name: SW MATCH 135, product: FRN, rating: A-
name: LANDSHYP 197, product: FIX, rating: BBB+	name: SW MATCH 136, product: FRN, rating: A-
name: LANDSHYP 198, product: FRN, rating: BBB+	name: SW MATCH 137, product: FRN, rating: A-
name: LANDSHYP 199, product: FIX, rating: BBB+	name: SW MATCH 138, product: FRN, rating: BBB+
name: LANDSHYP 200, product: FIX, rating: BBB+	name: SW MATCH 139, product: FRN, rating: A-
name: LANDSHYP 301, product: FRN, rating: BBB+	name: SW MATCH 140, product: FRN, rating: A-
name: LANDSHYP 302, product: FRN, rating: BBB+	name: SW MATCH 141, product: FRN, rating: BBB+
name: LANDSHYP 303, product: FIX, rating: BBB+	name: SW MATCH 142, product: FIX, rating: BBB+
name: LANDSHYP 304, product: FIX, rating: BBB+	name: TEKVER 05/16, product: FRN, rating: A-
name: LANDSHYP 305, product: FIX, rating: BBB+	name: TEKVER 09/17, product: FRN, rating: A-
name: LANDSHYP 306, product: FRN, rating: BBB+	name: TEKVER 11/09, product: FRN, rating: A-
name: LANDSHYP 307, product: FIX, rating: BBB+	name: TEKVER 4.15 09, product: FIX, rating: A-
name: LANDSHYP 308, product: FIX, rating: BBB+	name: TELIA 10, product: FRN, rating: A
name: LANDSHYP 309, product: FIX, rating: BBB+	name: TELIA 11/16, product: FRN, rating: A
name: LANDSHYP 310, product: FRN, rating: BBB+	name: TELIA 17, product: FRN, rating: A-
name: LANDSHYP 311, product: FIX, rating: BBB+	name: TELIA 18, product: FRN, rating: A-
name: LANDSHYP 312, product: FIX, rating: BBB+	name: TELIA 19, product: FRN, rating: A-
name: LANDSHYP 313, product: FRN, rating: BBB+	name: TELIA 20, product: FRN, rating: A-
name: LANDSHYP 314, product: FRN, rating: BBB+	name: TELIA 204, product: BULLET, rating: A
name: LANDSHYP 315, product: FRN, rating: BBB+	name: TELIA 21, product: FRN, rating: A-
name: LANDSHYP 316, product: FRN, rating: BBB+	name: TELIA 210, product: BULLET, rating: A
name: LANDSHYP 317, product: FRN, rating: BBB+	name: TELIA 212, product: BULLET, rating: A
name: LANDSHYP 318, product: FRN, rating: BBB+	name: TELIA 213, product: BULLET, rating: A
name: LANDSHYP 319, product: FIX, rating: BBB+	name: TELIA 214, product: BULLET, rating: A
name: LANDSHYP 320, product: FIX, rating: BBB+	name: TELIA 216, product: BULLET, rating: A
name: LANDSHYP 321, product: FIX, rating: BBB+	name: TELIA 217, product: BULLET, rating: A
name: LANDSHYP 323, product: FRN, rating: BBB+	name: TELIA 22, product: FIX, rating: A-
name: LANDSHYP 5027, product: BULLET, rating: BBB+	name: TELIA 23, product: FIX, rating: A-
name: LANDSHYP 5029, product: BULLET, rating: BBB+	name: TELIA 24, product: FRN, rating: A-
name: LANDSHYP 5033, product: BULLET, rating: BBB+	name: TELIA 25, product: FIX, rating: A-
name: LANDSHYP 5035, product: BULLET, rating: BBB+	name: TELIA 26, product: FRN, rating: A-

name: LANDSHYP FLG 07, product: FIX, rating: BBB+	name: TELIA 27, product: FRN, rating: A-
name: LANDSHYP FLG 09, product: FIX, rating: BBB+	name: TELIA 275, product: FRN, rating: A
name: LANDSHYP FLG 10.2 05, product: FIX, rating: BBB+	name: TELIA 278, product: FRN, rating: A
name: LANDSHYP FRN 07, product: FRN, rating: BBB+	name: TELIA 280, product: FRN, rating: A
name: LF BANK 102, product: FRN, rating: BBB+	name: TELIA 281, product: FRN, rating: A
name: LF BANK 103, product: FRN, rating: BBB+	name: TELIA 282, product: FRN, rating: A
name: LF BANK 104, product: FRN, rating: BBB+	name: TELIA 29, product: FIX, rating: A-
name: LF BANK 105, product: FRN, rating: BBB+	name: TELIA 3.5 15, product: CPI, rating: A-
name: LF BANK 106, product: FRN, rating: BBB+	name: TELIA 3.5 2015, product: CPI, rating: A-
name: LF BANK 107, product: FRN, rating: BBB+	name: TELIA 4.25 15, product: FIX, rating: A-
name: LF BANK 108, product: FRN, rating: BBB+	name: TELIA 4.5 14, product: FIX, rating: A
name: LF BANK 109, product: FRN, rating: BBB+	name: TÄBY KN 107, product: BULLET, rating: AA+
name: LF BANK 110, product: FRN, rating: BBB+	name: TÄBY KN 108, product: BULLET, rating: AA+
name: LF BANK 111, product: FRN, rating: BBB+	name: TÄBY KN 109, product: FIX, rating: AA+
name: LF BANK 112, product: FRN, rating: BBB+	name: TÄBY KN 110, product: FIX, rating: AA+
name: LF BANK 113, product: FRN, rating: BBB+	name: TÄBY KN 111, product: FIX, rating: AA+
name: LF BANK 114, product: FRN, rating: BBB+	name: VATTENFALL 0 10/16, product: FRN, rating: A-
name: LF BANK 115, product: BULLET, rating: BBB+	name: VATTENFALL 11, product: BULLET, rating: A-
name: LF BANK 116, product: BULLET, rating: BBB+	name: VATTENFALL 110, product: BULLET, rating: A-
name: LF BANK 117, product: BULLET, rating: BBB+	name: VATTENFALL 112, product: FRN, rating: A-
name: LF BANK 118, product: FRN, rating: BBB+	name: VATTENFALL 12, product: BULLET, rating: A-
name: LF BANK 119, product: BULLET, rating: BBB+	name: VATTENFALL 121, product: FIX, rating: A-
name: LF BANK 120, product: FRN, rating: BBB+	name: VATTENFALL 122, product: FIX, rating: A-
name: LF BANK 121, product: FRN, rating: BBB+	name: VATTENFALL 13, product: BULLET, rating: A-
name: LF BANK 122, product: FRN, rating: BBB+	name: VATTENFALL 15, product: BULLET, rating: A-
name: LF BANK 123, product: BULLET, rating: BBB+	name: VATTENFALL 16, product: BULLET, rating: A-
name: LF BANK 124, product: BULLET, rating: BBB+	name: VATTENFALL 17, product: BULLET, rating: A-
name: LF BANK 125, product: FRN, rating: BBB+	name: VATTENFALL 18, product: BULLET, rating: A-
name: LF BANK 126, product: FRN, rating: BBB+	name: VATTENFALL 19, product: BULLET, rating: A-
name: LF BANK 127, product: BULLET, rating: BBB+	name: VATTENFALL 20, product: BULLET, rating: A-
name: LF BANK 128, product: FRN, rating: BBB+	name: VATTENFALL 22, product: BULLET, rating: A-
name: LF BANK 129, product: BULLET, rating: BBB+	name: VATTENFALL 23, product: BULLET, rating: A-
name: LF BANK 130, product: FRN, rating: BBB+	name: VATTENFALL 24, product: BULLET, rating: A-
name: LF BANK 131, product: FRN, rating: BBB+	name: VATTENFALL 25, product: FRN, rating: A-
name: LF BANK 132, product: BULLET, rating: BBB+	name: VATTENFALL 26, product: BULLET, rating: A-
name: LF BANK 133, product: BULLET, rating: BBB+	name: VATTENFALL 27, product: BULLET, rating: A-
name: LF BANK 134, product: FRN, rating: BBB+	name: VATTENFALL 3.408 05, product: FRN, rating: A-
name: LF BANK 135, product: FRN, rating: BBB+	name: VATTENFALL 30, product: BULLET, rating: A-
name: LF BANK 136, product: BULLET, rating: BBB+	name: VATTENFALL 31, product: FRN, rating: A-
name: LF BANK 137, product: BULLET, rating: BBB+	name: VATTENFALL 32, product: BULLET, rating: A-
name: LF BANK 138, product: FRN, rating: A-	name: VATTENFALL 42.5 09, product: FRN, rating: A-
name: LF BANK 139, product: FRN, rating: A-	name: VATTENFALL 5.75 07, product: BULLET, rating: A-
name: LF BANK 140, product: FIX, rating: A-	name: VATTENFALL 65, product: FRN, rating: A-
name: LF BANK 141, product: FIX, rating: A-	