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Prediction of Credit Spread Movements in The Context of The South African Market

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Abstract

A credit spread is the extra risk-reward that an investor is bearing for investing in corporate bonds instead of Government Bonds. This research uses transactional data over a period of approximately 11 years to investigate the determinants of monthly credit spread changes in the context of the South African market. For this period a final bond sample consisting of 390 different bond issues and a total of 2,020 monthly observations were obtained. Each of the observations were grouped according to the leverage ratio of the issuing company. In the analysis an optimal set of both company-level and market-wide variables, mostly inspired by structural models of default were used. Initially the analysis was done for all observations across all leverage groups. From this it was observed that the identified set of variables explain at most 27% of the variation in monthly credit spread changes. To study the effect of the time to maturity the observations were subdivided according to three different maturity groups. The following groups were constructed: Short (less than 4 years), Medium (4 to 8 years) and Long (more than 8 years). The analysis was done over all leverage ratios across these three different maturity groups. The adjusted R-squared varied between 0.00% and 66.51%. Further, the method of principal components analysis was applied on the residuals to get a better understanding of the unexplained variation. It was observed that more than 40% was due to the first two principal components. No dominant latent factor was present in the unexplained variation. Finally, it was concluded that most of the explanatory variables investigated have some ability to explain changes in credit spreads.

Opsomming

‘n Kredietverspreiding word geag as die ekstra vergoeding wat ‘n belegger addisioneel tot die riskikovrye koers vereis vir die addisionele risiko rakende ‘n belegging in korportatiewe- eerder as staatseffekte. In hierdie navorsingswerkstuk word transaksionele data van korporatiewe effekte gebruik om die invloed van verskillende veranderlikes op maandelikse kredietverspreiding bewegings te ondersoek. Die veranderlikes word hoofsaaklik deur verskeie bestaande teoreties modelle gemotiveer en ondersteun. In die navorsingswerkstuk is die veranderlikes wat geïdentifiseer is in twee oorhoofse groepe verdeel. Die twee groepe sluit in veranderlikes wat spesifiek verband hou met die maatskappy wat die effekte uitgereik het en die ander groep is markverwante veranderlikes. Die tydperk onder oorsig is ongeveer 11 jaar en die studie is spesifiek uitgevoer in die konteks van die Suid-Afrikaanse mark. Die finale steekproef wat in die navorsing gebruik word bestaan uit 390 verskillende effekte wat uitgereik was gedurende die tydperk onder oorsig. Dit het ‘n totaal van 2,020 maandelikse obserwasies opgelewer. Elk van die 2,020 observasies was gegroepeer ingevolge die hefboomfinansieringverhouding van die maatskappy wat die effek uitgereik het. Aanvanklik was die analisering van die data op die hele steekproef uitgevoer regoor al die hefboomfinansieringverhouding wat gekonstrueer is. Met hierdie analise is waargeneem dat die veranderlikes wat in die model gebruik is ongeveer 27% van die maandelikse kredietverspreidingsveranderinge verduidelik. Daarna is die obserwasies in elk van die hefboomfinansieringsverhouding groepe ingevolge die tyd wat hulle verjaar ingedeel. Die volgende drie groepe is geskep: Kort (minder as 4 jaar), Medium (4 tot 8 jaar) en Lang (meer as 8 jaar). Die analise is gedoen oor al drie die groepe. Die aangepaste R-kwadraat waarde het gewissel tussen 0.00% en 66.51%. Verder was hoofkomponentanalise toegepas op die residuele waardes om die onverklaarbare variasie beter te verstaan. Dit was waargeneem dat meer as 40% van die onverklaarbare variasie was as gevolg van die eerste twee hoofkomponente. Geen dominante latente faktor was aanwesig in die onverklaarbare variasie nie. Ten slotte was dit gevind dat meeste van die verklaarbare veranderlikes waarin ondersoek ingestel was wel sommige van die veranderinge in kredietverspreidings kan verduidelik.

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Credit spreads are defined as the difference in the yields of two bonds with similar maturity but different credit quality. It is usually the difference between the yield of a corporate bond and the yield of a Government Bond with a similar maturity, since the yield on a Government Bond is regarded as risk-free. For example, if a 10-year Government Bond is trading at a yield of 8.5% and a 10-year corporate bond is trading at a yield of 10.5%, the corporate bond is said to offer a 200-basis point spread above the risk-free yield.

Corporate bonds, even for the most stable and highly rated companies, are considered as a riskier investment for which the investor requires compensation. Voss (2012) and Castagnetti and Rossi (2013) state that credit spreads are the risk premium that an investor is rewarded with for bearing extra risk, and that risk premium varies among companies as well as bond ratings (Jargic, 2017).

The main purpose of this study is to investigate how well determinants motivated by structural models plus additional market-wide variables can explain monthly variation in corporate credit spreads in the context of the South African market.

Credit spread changes could occur mainly due to changes in economic conditions (such as inflation), changes in liquidity and demand for investment within a several markets. As stated by Avramov, Jostova and Philipov (2007), it is very important to understand the difference between studying credit spread changes and not the credit spread level as defined. The credit spread level is directly related with bond pricing while credit spread changes is associated with excess returns on bonds.

Much research has been published on corporate yield spreads but much less on corporate credit spread changes.

Collin-Dufresne, Goldstein, and Martin (2001) noted that when investigating the behaviour of corporate credit spreads an adjusted R-squared of around 60 percent is obtained whereas the adjusted R-squared drop to approximately 5 percent when studying variation in credit spread changes. Collin-Dufresne et al. (2001) found that variables from structural models explain approximately 25 percent of the variation in credit spread changes. From this they noted the efficiency of structural models alone in explaining the variation in corporate credit spread changes are not enough. Avramov et al. (2007) subsequently attempted to determine the drivers of credit spread changes. In their research they did not formally implement a structural model to predict credit spread movements, but rather added market-wide variables to the existing company-level variables. They found that for low grade (high risk) corporate bonds approximately 68 percent of the variation in credit spread changes were explained while it was 34 percent with high grade (low risk) bonds. This substantial improvement in the results from what was found by Collin-Dufresne, et al. (2001) is mainly because they also included high-yield bonds and additional market-wide variables in their analysis.

Radier, Majoni, Njankike, and Kwaramba (2016) applied structural models explicitly in the context of South African data, from which they concluded that these variables were indeed significant in explaining daily corporate credit spread changes. This research will expand on Radier et al. (2016) by considering monthly credit spread changes instead of daily credit spread changes and incorporating market-wide variables in the analysis.

The prediction of credit spread changes are important for numerous market participants because the ability to predict changes in credit spreads accurately could result in trading profits. It is important to note that the change in yields of the corporate bonds are driven by two factors – the underlying risk-free curve and the spread. The movement of the government bond can easily be hedged out by taking an opposite position in the companion government bond, leaving only exposure to the credit spread. This therefore allows the investor to speculate on the movement of the credit spread and should he be successful in predicting the changes could result in profits.

Conversely, hedge funds often take highly leveraged positions on corporate bonds through shorting Government Bonds (Collin-Dufresne et al., 2001). Thus, they sell Government Bonds and use the proceeds to buy corporate bonds. The hedge fund will make a profit when the price of the Government Bonds decreases or the price of the corporate bonds increase. Because of the inverse relationship between the yield of a bond and its price, this will occur when the yields on the Government Bonds increase or the yield on the corporate bonds decrease. In this case, profits will be generated by narrowing credit spreads.

Additional to the practical benefits of this study, the results of all papers which studied the same problem, measured by the adjusted R-squared can be used as an indication of how well the different theoretical models used in the various papers explain the variation in credit spread changes. These results can be used to improve existing models or develop new models to make predictions even more accurate so that it can be successfully used in practice.

Further, widening credit spreads are also an indication of worsening economic conditions. When investors are anticipating difficult economic conditions, they tend to buy Government Bonds and sell corporate bonds. The consequence of this action by the investors to switch between this different bond types will be that the prices of corporate bonds will decrease (increase in the yield) and the prices of Government Bonds will increase (decrease in the yield). The net result of this will be a widening in the credit spreads. A decrease in credit spreads will be an indication that investors are expecting an improvement in the economic conditions.

The remainder of this research is organized as follows. The first section of Chapter 2 will begin with a short discussion on the South African bond market. It will be followed by a brief overview of structural models of default. The chapter is then concluded on a discussion of the potential determinants identified to predict credit spread changes and their expected relationship with credit spread changes.

Chapter 3 underlines all relevant aspects regarding the data used in this paper. The discussion includes which data were used, where it was obtained and how it was used to proxy the different determinants identified in the previous chapter.

Chapter 4 starts off by providing a summary of methodology and results of the most important papers which this research is based on. The purpose of this section is to highlight the origin of the different ideas used in this research. These ideas are especially used in the following sections of this chapter and in the subsequent chapter. The next section continues with a detailed discussion on the methodology used to analyse the data. Chapter 4 also includes a complete interpretation of the results obtained. Finally, these results are then compared to findings of prior studies.

The thorough interpretation of the results in Chapter 4 are used in Chapter 5 to make a general conclusion regarding the research question and the results obtained. It is also compared to prior studies. Considering the weaknesses, strengths and limitations of this study, there are opportunities for future research. The paper will then conclude with recommendations in this regard.

CHAPTER 2
THEORETICAL FRAMEWORK

This chapter examines existing literature regarding potential determinants of credit spread changes. The first section is a short discussion on the South African bond market. It will be followed by a brief overview of structural models of default since structural models of default provide an intuitive framework for identifying determinants of credit spread changes. The last section discusses the credit spread determinants used in the analysis and how it is expected to influence the monthly credit spread changes.

2.1 BACKGROUND TO THE SOUTH AFRICAN BOND MARKET

The South African bond market is monitored and regulated by Bond Exchange of South Africa (BESA), which is a subsidiary of the Johannesburg Stock Exchange (JSE) (JSE, 2013).

It is the largest debt market in Africa, both by market capitalization and by liquidity. It is worth (outstanding bonds) approximately US$180 billion, as of 2013, translating to 31% of GDP (JSE, 2013). A market size of US$100 billion and above is qualified to be large and liquid (McCauley and Remolona, 2000).

The South African bond market is the most liquid in Africa (Capital, 2012). This is due to its bigger size and large number of participants. Trading on the BESA accounts for over 90% of turnover on the continent (Capital, 2012). Average daily trades average around R25 billion (JSE, 2013), while velocity circulation is estimated to be above 20 times (Lawless, 2005).

The activity in the South African bond market is dominated by the government bonds which are estimated to make up more than 94% of the trading activity (Hassan, 2013).

The secondary market for corporate bonds is illiquid with little market making activity (Lawless, 2005).

The BESA is a well-diversified market in terms of bond issues, bond classes, maturity structure and participants. The total number of instruments amount to around 1,600 instruments and the issuers include central and local government, parastatals, banks and corporates. The Government Bonds constitute a bigger portion (around 55%, or US$100 Billion) of the SA bond issues, the rest were issued by state-owned companies, corporates, and banks.

In terms of maturity structure, the Government Bonds cover a wide range of maturities, from one year to above thirty years, which provide a reliable bond yield curve for pricing corporate bonds and deriving forward rates (Liu, 2013).

The South African financial market regulation does not impose restrictions on the purchase and ownership of bonds by foreign investors (JSE, 2013). Consequently, foreign investor participation is high on the market and it constitutes more than 37% of government bond holdings (Department National Treasury South Africa, 2014). Foreign investor participation broadens the investor base and it adds stability, liquidity, efficiency in price discovery. On the other hand, empirical research shows that foreign investors participation lowers bond yields and induces high volatility in the bond market (Andritzky, 2012). The high volatility is induced through the frequent purchase (inflows) and sales (outflows) in search of high yields and in response to increased risk, while lower yields are a consequence of increased prices due to high demand.

South Africa is one of the 27 countries in the world that adopted the inflation targeting framework as the anchor of their monetary policy (Barnebeck Andersen, Malchow-Møller and Nordvig, 2014). Under the inflation targeting framework, the Reserve Bank adjusts the repurchase rate (repo rate) to control inflation and keep it with in a targeted band of 3%-6%.

With this framework the South African Reserve Bank directly influences short-term rates by setting and adjusting the repo rate in response to forecasted deviations of inflation. The movements in the short-term interest rates through changes in the repo rate, in turn affect two of the factors under consideration in this study, the yield curve slope and the interest rate level. Movements of short-term rates due to changes in the repo rate affect the yield curve slope and the long-term interest rates. In addition, it also affects the level of interest rates which determine the risk, required rate of return and prices of bonds and interest rate derivatives (Hassan, 2013).

The purpose of this section was to highlight some of the key facts of the environment in which this research was conducted. Since environmental background is now known the following section will continue by discussing the theoretical framework on which this research is based on.

2.1 BRIEF OVERVIEW OF STRUCTURAL MODELS OF DEFAULT

Credit risk models can be divided into two broad categories:

i. *Structural models*: These models assume that a default can be explained by a specific trigger point, for example it can be caused by decrease in asset value below some threshold (i.e. the value of debt). The value of assets itself is modelled as a stochastic process.

ii. *Reduced-form models*: These models assume that defaults are driven by a default intensity. No specific trigger event is assumed, but the default intensity (or default rate) might depend on changes in external factors (GDP growth, inflation, unemployment, interest rates etc.). This relationship is estimated using historical data and econometric techniques.

The most well-known structural model is the Merton (1974) model. The model estimates the probability of default of a company based on the simple structure of its statement of financial position.

The statement of financial position consists of assets (A_t), liabilities which can be further divided into equity (E_t) and debt (D_t), and needs to satisfy the following accounting identity:

$$A_t = D_t + E_t. \quad (2.1)$$

The value of equity (E_t) can be thought of as what the company is worth for the equity holders (owners) of the company.

With structural models there is one binary observable variable, either the company defaults or does not default. This binary observable variable is based on a latent variable (variable which are not directly observed but you can make a conclusion through a mathematical model with observable variables as input). In the Merton (1974) model the latent variable is the value of the assets (A_t) of the company, since we only know the accounting value of the assets and it is also only reported on an annual basis most of the time.

The main assumption of the model is that the company will default if the real value of its assets is below the value of its debt at the time of maturity of the debt (T), i.e. $A_T < D_T$, since

$A_T = D_T + E_T$

From the basic accounting equation of a company which is defined as, Assets = Liabilities + Equity.

$=> E_T = A_T - D_T$

$If\ A_T < D_T, then$

$E_T < 0.$

Therefore if $E_T < 0$, the company has no value and therefore defaults. In this case the owner of the firm gets nothing, and the value of its equity is zero ($E_T = 0$), and the creditor only receives a portion of their debt, i.e. his pay-off is only A_t instead of D_t.

On the contrary, if at time T the real value of the assets exceeds the value of debt ($A_T > D_T$), then the debt is fully repaid and the value of the equity equals *to* $E_T = A_T - D_T$.

It is assumed that the value of the assets (A_t) of company follow a stochastic process, i.e. a geometric Brownian motion to be specific.

With a listed company which actively trades on a stock exchange, the daily value of E_t (the number of issued shares multiplied by the value per share) is known. The daily values of A_t can be then estimated from the daily values of E_t using the following procedure.

Since A_T is a random variable it is not known which of the two statements above (default or non-default) occurs. The company value at time T can be summarized as follows:

$$E_T = max\,(A_T - D_T, 0). \tag{2.2}$$

Note that this is the pay-off of a call option written on the real value of the firm's assets as an underlying and D_T as the strike price. The value of equity (E_t) can be calculated using the Black-Scholes option pricing formula. Therefore, the payment of debt for the equity holders is very similar to that of a European call option. In the case of a European call option the equity holders (i.e. the owners) have the right (but not the obligation) to pay-off the creditors and take over the remaining assets of the firm at time T. If they decide to do so, the firm continues to operate. Otherwise, the firm goes bankrupt. Practically this is not exactly how it works. In real life the company have an obligation to repay all its creditors. When the company is not in the position to repay all its debt then the amount of debt that will be amortised will be equal to the value assets of the company at that stage.

Bondholders have a long position on a firm's underlying assets, but they have sold a call option to the shareholders. Let B_T be the value of the bond.

$$B_T = A_T - max\,(A_T - D_T, 0). \tag{2.3}$$

From this equation it is clear that anything that will increase the value of the European Call Option will lead to a decrease in the value of the bond. A decrease in a bond price is a result of an increase in the yield of the bond. Thus, an increase in the value of the call option will increase the credit spread and vice versa for a decrease in the price in the option.

The variables used in the Black-Scholes option pricing formula for calculating the value of the European call option is given by:

$$E_t = call(A_t, \mu_A, \sigma_A, r, D_T, T) \tag{2.4}$$

Table 1 shows how the price of a European call option is affected by increasing one of the input variables while keeping all the other input variables fixed.

Table 1

Effect on the price of a European call option by increasing one variable while keeping all others fixed

	A_T	D_T	$T-t$	σ	r
European Call Option	+	-	?	+	+

? The relationship is uncertain

2.1.1 Distance-to-Default

With structural models the probability of default is a function of the company's fundamentals especially its assets and liabilities. From figure 1 the initial value of the assets is indicated by ①.

Default occurs when the value of company's asset falls below "Default Point" (indicated by ④) which is the value of the debt of the company. It is easy to calculate the current Distance-to-Default indicated by "DD" since all values are known. Complexity arises when this needs to be determined for some time in the future. To do this the volatility and the expected return on the company's assets are needed. The volatility and expected return are calculated by using option pricing theory. With this fully defined distribution it is now possible to determine the probability of default for a specific time in the future.

The distance-to-default is calculated with equation 2.5, which is the same as the formula used in the Merton (1974) model.

$$d_2 = \frac{\ln\left(\frac{V_0}{Default\ Point}\right) + \left(\mu - \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \tag{2.5}$$

where:

$\ln\left(\frac{V_0}{Default\ Point}\right)$	The percentage that the current value of the firm needs to decrease by to default.
$\left(\mu - \frac{\sigma^2}{2}\right)T$	The expected growth on a firms' assets by incorporating volatility up to a specific time in the future.
$\sigma\sqrt{T}$	Standardise the expression to standard normal units.

It is important to note that option pricing theory is not used when calculating distance-to-default at a specific time in the future. Option pricing theory is only used at the very beginning of the calculation when the value and volatility of the company's assets is determined. To calculate the distance-to-default, which is quantified as the number of standard deviations, at a specific time in the future elementary statistics is used.

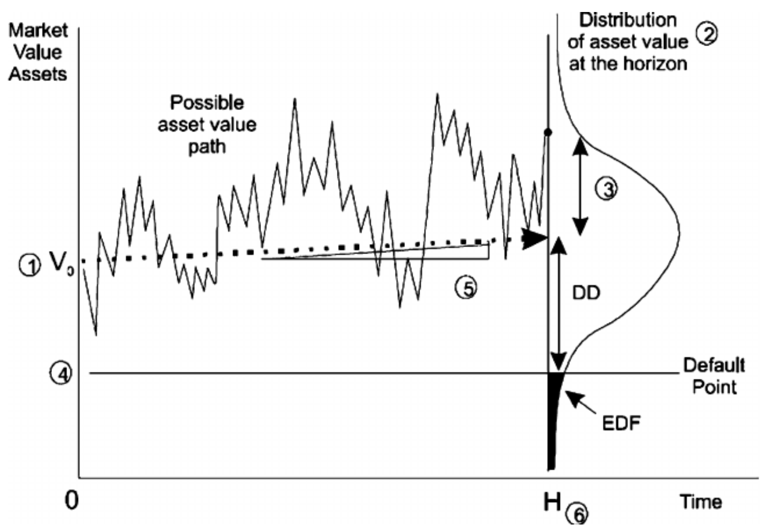


Figure 1

2.2 POTENTIAL DETERMINANTS OF CREDIT SPREAD CHANGES

Avramov et al. (2007) notes that Jones, Mason, and Rosenfeld (1984) and Kim, Ramaswamy, and Sundaresan (1993) found that structural model variables explain only a small fraction of credit risk. Collin-Dufresne et al. (2001) also found that structural models fail to predict credit spread changes sufficiently.

This research follows similar approach to that of Avramov et al. (2007) where the potential determinants of credit spread changes are not only motivated by structural models but includes additional market-wide variables as well.

Initially, a whole collection of potential determinants motivated by structural models of default and various previous studies were considered. For example, some of the potential determinants considered but not used in the analysis includes change in exchange rate, change in inflation, change in volatility (not idiosyncratic equity volatility) and change price-to-book ratio at both company- and market-wide level. Further, various change in spot rates (e.g. 2-year, 5-year, 10-year, 30-year) and change in the slope of the yield curves (e.g. 5Y-2Y, 10Y-2Y, 30Y-2Y) were considered as well. This aggregate set of potential determinants were reduced to the final set that was used in this research by applying stepwise regression with backward elimination. It was decided from the start that potential determinants motivated by structural models of default must be included in the final set of potential determinants. The optimal set of explanatory variables identified from the variables motivated by structural models of default were:

i. Leverage,
ii. Change in 5-year spot rate,
iii. Change in slope of the yield curve (10Y-2Y), and
iv. Change in idiosyncratic equity volatility.

Further, stepwise regression identified the following variables as the significant in explaining monthly credit spread changes from the remaining variables which were not explicitly motivated by structural models of default:

i. Equity market return
ii. Stock return momentum
iii. Change in Illiquidity

The potential determinants of credit spread changes were divided into company-level variables and market-wide variables. The following section is a discussion on the theoretical background of each of these identified variables and what their expected effect on credit spread changes will be.

2.2.1 Company-Level Variables

2.2.1.1 Leverage

From Collin-Dufresne et al. (2001), the default threshold is determined by the capital structure of the firm. As the total liabilities of a firm increases the distance to default decreases. Therefore, credit spreads are expected to widen with increased amount of debt. Welch (2004) noted that stock price effects are much more successful in explaining debt-equity ratios compared to other previously identified proxies. According to Welch (2004) stock returns are the primary known component of capital structure and capital structure changes.

2.2.1.2 Stock Return Momentum

Jegadeesh and Titman (1993) concluded that investment strategies which purchase stocks that have performed well in the past and sell stocks that have performed poorly in the past generate significant positive returns over short-to-medium periods. It can be interpreted that past “winners” continue to outperform past “losers” over the short-to-medium term (Avramov et al., 2007).

Thus, a higher momentum in equity returns implies higher future company valuation, which increases the distance to default. This implies lower credit spreads (Avramov et al., 2007).

Avramov et al. (2007) established a strong link between credit rating and momentum in equity returns. Prior to Avramov et al. (2007), the effect of stock return momentum on credit spread changes have not previously been studied.

2.2.1.3 Change in Idiosyncratic Equity Volatility

Intuitively, an increase in volatility will enlarge the probability that the firm will reach its default threshold, which will lead to bond holders demanding higher yields to compensate for increased risk (Radier et al., 2016).

According to Collin-Dufresne et al. (2001), a high volatility increases the value of the contingent-claim. From equation 2.3 it can be seen that an increase in the value of the contingent claim will reduce the value of the bond. Decreasing bond prices are associated with increasing yields, which will lead to a widening in credit spreads.

Structural models assume that the value of a company’s assets is driven by total firm volatility. Total firm volatility includes both idiosyncratic (unsystematic) volatility and market-wide (systematic) volatility (Campell, and Taksler, 2003). Idiosyncratic risk is the risk relating specifically to the company and not the market as a whole, i.e. the undiversifiable risk. Therefore, idiosyncratic volatility is used to quantify the volatility specific to a company. It can move very different from market-wide volatility. In general equity market volatility is used to proxy total company volatility (Avramov et al., 2007). Campbell and Taksler (2003) researched the effect of what idiosyncratic equity volatility has on bond prices. They found a strong link between rising idiosyncratic equity risk and increasing yields on corporative bonds relative to Government Bonds.

Except for Avramov et al. (2007) who considered change in idiosyncratic volatility as a potential determinant for credit spread changes, little is known about this relationship.

2.2.1.4 Change in Illiquidity

Longstaff, Mithal, and Neis (2005) suggest that illiquidity may be a possible determinant in predicting credit spread changes. In Chen, Lesmond and Wei (2007) they consider the relationship between bond specific illiquidity and the yield spread of that bond and find that the illiquidity of a bond explains an important portion of the bond credit spread. They concluded that more illiquid bonds have higher credit spreads. Bao, Pan and Wang (2010) indicated that illiquidity is important in the pricing of corporate bonds, but the evidence is mostly qualitative and indirect. The main goal of Bao et al. (2010) was to determine a more direct answer to what degree the illiquidity of a corporate bond has on its price and corporate bond credit spreads at both company-level and market-wide level. Bao et al. (2010) used several illiquidity measures and found that there is a strong link between bond illiquidity and bond prices.

In this research the relationship between change in illiquidity and credit spread changes and not the credit spread level is investigated.

2.2.2 Market-Wide Variables

2.2.2.1 Change in Spot Rate

Longstaff and Schwartz (1995) pointed out that a higher spot rate increases the risk-neutral drift rate of the firm value process. A higher drift reduces the probability of default, and in turn, reduces the credit spreads (Collin-Dufresne, Goldstein, and Martin, 2001). High levels of interest rates imply high reinvestment rates, which increases a company's future value (Avramov et al., 2007).

In addition, high interest rates raise the expected growth rate of the firm's cash flows and firm value, hence reducing the likelihood that the company's value will fall below a certain threshold (Boss and Scheiber, 2002).

Therefore, the impact of the high cash flows, high growth rates and high expected firm values due to high interest rates is to lower probability of the company defaulting and the firm value falling below a certain threshold. The distance to default increases.

To capture potential nonlinear effects due to convexity the squared value of the change in spot rate is also included in the analysis.

2.2.2.2 Change in Slope of the Yield Curve

The slope of the yield curve between two government bonds is defined as the difference between the yield of a longer-term government bond and the yield of a shorter-term government bond. The magnitude of the difference determines the steepness of the yield curve. The bigger the magnitude the steeper the yield curve and vice versa (Radier et al., 2016).

The slope of the yield curve contains two sets of information for investors which results in two competing hypotheses as stated by Avramov et al. (2007), namely:

i. An increase in the slope implies higher future spot rates, thereby reducing credit spreads. In addition, Fama and French (1989) argued that a steepening in the slope of the yield curve is an indication of higher future economic growth. A positive gradient implies that the short-term interest rates are lower than the longer-term interest rates. Since there is no incentive for people to invest money at the low current interest rate there is a lot of cash in the market. Therefore, the economy is stimulated and grow. But a growing economy is at the expense of a higher inflation and causes future interest rates to increase to compensate for the loss of purchasing power (Segal, 2019). This reduces the probability of default and therefore reduces credit spreads.
ii. Avramov et al. (2007) argued that the increase in expected future spot rates, which can be deduced from a steepening yield curve, may decrease the number projects with a positive net present value (NPV) available to the company. This is from the fact that the cashflows of the different projects are discounted with a higher interest rate when they are valued. The decline in the value of the company and its assets will shrink the distance to default therefore the credit spreads will increase.

2.2.2.3 Change in Business Climate

The credit spread on a bond is defined by:

$$Credit\ Spread = (1 - Recovery\ Rate) \times (Default\ Probabilty). \tag{2.1}$$

Collin-Dufresne et al. (2001) argued that you can still experience changes in the credit spread of the bond even is the probability of default of the firm remains constant. Changes in credit spreads can occur due to changes in the expected recovery rate. Altman and Kishore (1996) stated that the expected recovery rate of a firm is related of the overall business climate. Thus, an improvement in the overall business climate should decrease credit spreads.

2.2.2.4 Fama-French Factors

Elton, Gruber, Agrawal, and Mann (2001) showed that the credit spread compensates for exposure to market-wide risk factors, namely, the Fama and French (1993) factors. For robustness and comparison, we studied the predictive power of the Fama-French factors in the presence of our proposed set of structural variables.

This chapter aimed to identify potential determinants of credit spread changes and discussed their possible effects on this subject. This was done by using structural models of default and considering various existing literature. Given that the potential determinants of credit spread changes have been identified and how each one of them is motivated, the following chapter will consider which data were used, where it was obtained and how it will be used to proxy each one of them.

CHAPTER 3
DATA

The aim of this research is to determine how well the identified determinants from the previous chapter explains the variation in monthly credit spread changes. This chapter starts off with a discussion on what and where the data is obtained. It includes a thorough discussion on how the dependent variable, which is the change in credit spreads, have been calculated. This is followed with a discussion on how the data is used to proxy all the potential determinants identified in the previous chapter. It then concludes on how the entire sample is filtered to arrive at the final bond sample which will be used in the analysis in the next chapter.

3.1 CREDIT SPREAD CHANGES

Daily quoted credit spreads and credit spreads at which transactions took place in the South African market for the period under consideration 1 October 2007 to 30 April 2018 were obtained from IRESS.

The credit spread of a corporate bond at *time t* is defined:

$$Credit\ Spread_t = Corporate\ Bond\ Yield_t - Benchmark\ Yield_t. \tag{3.1}$$

Where the $Benchmark\ Yield_t$ is the yield of a Government Bond with a comparable maturity of that of the corporate bond. It follows that the credit spread change at *time t* is the difference of the credit spreads at *time t = t* and *time t = t-1*.

To calculate the credit spread for each *bond i* during a specific month an average of the credit spreads at which transactions took place during that month were used. The credit spread change, as calculated at the end of a month is defined as the difference between the averaged credit spread values of the current month and the previous month.

Suppose that there is k daily dealer quoted credit spreads during *month t* where each quote is indicated by $QuotedCS$. Equation 3.2 is used to calculate the credit spread of *bond i,* during *month t*:

$$CS_t^i = \frac{1}{k}\sum_{q=1}^{k} QuotedCS_q \tag{3.2}$$

The change in credit spread of *bond i* for *month t* is calculated by equation 3.3:

$$\Delta CS_t^i = CS_t^i - CS_{t-1}^i \tag{3.3}$$

3.2 EXPLANATORY VARIABLES

3.2.1 Company-Level Variables

3.2.1.1 Leverage

Since Welch (2004) have found that stock price effects are much more successful in explaining debt-equity ratios than the traditional debt-equity ratios the following are used to proxy leverage. For each *bond i*, the monthly log-return on the stock of the corresponding issuing company is calculated to proxy the leverage.

Equation 3.4 is used to calculate the log-return for each *stock i* at the end of *month t*.

$$ret_t^i = \log S_t^i - logS_{t-1}^i \qquad (3.4)$$

where:

S_t^i The current stock price of *stock i*, and

S_{t-1}^i The stock price of *stock i* at the end of the previous month.

3.2.1.2 Stock Return Momentum

For each *bond i*, the stock return momentum value at the end of *month t*, indicated by mom_t^i, is defined the cumulative stock return over a two-month period ending at the beginning of the previous month (Brenna, Chordia, and Subrahmanyam, 1998). In this research it is calculated as the log-return on the stock price of the issuing company over this two-month period.

Equation 3.5 is used to calculate the stock return momentum value for each *stock i* at the end of *month t*.

$$mom_t^i = \log S_{t-2}^i - logS_{t-4}^i \qquad (3.5)$$

where:

S_{t-2}^i The stock price of *stock i* at the beginning of the previous month, and

S_{t-4}^i The stock price of *stock i* four months ago.

It is important to notice the difference in equations 3.4 and 3.5 which are used to proxy the leverage and stock return momentum variables respectively. In both cases the log-returns on the stock prices are used but it is for different time windows.

3.2.1.3 Change in Idiosyncratic Equity Volatility

Campbell and Taksler (2003) defined idiosyncratic equity volatility as the annualized standard deviation of the excess returns for a specific company relative to a suitable value-weighted index.

Avramov et al. (2007) calculated the idiosyncratic equity volatility for a specific month as the difference between monthly market volatility and monthly total company-level volatility.

The first step in determining idiosyncratic equity volatility is to calculate the sample standard deviation of the daily log-returns of both a specific company and a suitable value-weighted index during a particular month. The next step is to annualize this sample standard deviation calculated by multiplying it with a factor of $\sqrt{252}$.

Idiosyncratic equity volatility is calculated as the volatility of a specific stock during a month from which the corresponding volatility of the All Share Index (J203) is subtracted.

The change in the idiosyncratic equity volatility, as calculated at the end of the month is defined as the difference between the idiosyncratic equity volatility at the end of month and the beginning of the month.

3.2.1.4 Change in Liquidity

Equation 3.5 is used to calculate the monthly illiquidity measure for *bond i:*

$$Illiquidity_i = 1 - \frac{(Number\ of\ Days\ During\ a\ Month\ Actual\ Transactions\ Took\ Place)_i}{(Number\ of\ Days\ During\ a\ Month\ With\ Quoted\ Credit\ Spreads)_i} \tag{3.6}$$

It is constructed in such a way that it can only take on values between 0 and 1.

It compares the number of days during a month where transactions took place with the number of days during the corresponding month with available quoted credit spreads.

Therefore, if a bond was very illiquid during a specific month will it take on a value close to 1 versus a bond which traded on a more regular basis will have a liquidity measure value closer to 0. The change in liquidity is calculated as the difference between the illiquidity measure of the current month and the previous month.

3.2.2 Market-Wide Variables

3.2.2.1 Change in 5-Year Spot Rate

The daily 3-year spot rates and 6-year spot rates were obtained for the period under consideration. To calculate the spot rate at the end of a specific *month t* equation 3.7 was applied:

$$R_t^5 = R_t^3 + \frac{R_t^6 - R_t^3}{6-3} \times (5-3) \tag{3.7}$$

where:

R_t^3 Known 3-year spot rate at *time t*, and

R_t^6 Known 6-year spot rate at *time t.*

Equation 3.8 is then used to determine the change in the 5-year spot rate at the end of *month t.* It is defined as the difference between the 5-year spot rate at the end of the *month t* and the end of *month t-1*.

$$\Delta R_t^5 = R_t^5 - R_{t-1}^5 \tag{3.8}$$

where:

R_t^5 Calculated 5-year spot rate at the end of *month t*, and

R_{t-1}^5 Calculated 5-year spot rate at the end of *month t-1*.

The squared value of the change in the 5-year spot rate is denoted by $\left(\Delta R_t^5\right)^2$.

3.2.2.2 Change Slope of the Yield Curve (10Y-2Y)

The daily 2-year spot rates and 10-year spot rates were obtained for the period under consideration. To calculate the slope of the yield curve at the end of a specific *month t* equation 3.9 was applied:

$$SLOPE_t^{10-2} = R_t^2 - R_t^{10} \tag{3.9}$$

where:

R_t^2 Known 2-year spot rate at the end of *month t*, and

R_t^{10} Known 10-year spot rate at the end of *month t*.

Equation 3.10 is then used to calculate the change in the slope of the yield curve (10Y-2Y) at the end of *month t.* It is the difference between the slope of the yield curve (10Y-2Y) at the end of the *month t* and the end of *month t-1*.

$$\Delta SLOPE_t^{10-2} = SLOPE_t^{10-2} - SLOPE_{t-1}^{10-2} \tag{3.10}$$

where:

$SLOPE_t^{10-2}$ Calculated slope of the yield curve (10Y-2Y) at the end of *month t*, and

$SLOPE_{t-1}^{10-2}$ Calculated slope of the yield curve (10Y-2Y) at the end of *month t-1*.

3.2.2.3 Change in Business Climate

Change in business climate is proxied by the equity market return. To proxy for the overall business climate during a particular month the log-return on the All Share Index (ALSI) is used.

3.2.2.4 Fama-French Factors

A value for all three Fama-French factors were calculated at the end of each month by taking the difference of the monthly log returns between two appropriate indices for each defined factor. For each of the three factors the following indices are used in the context of the South African market.

i. *MKT Factor*: All Share Index (J203) – 10-Year risk free rate
ii. *SMB Factor*: Small Index (J202) - Top 40 Index (J200)
iii. *HML Factor*: Vali Index (J330) – Growi Index (J331)

Table 2 present the symbols used and the expected signs of the estimated regression coefficients. Note that the market-wide variables and company-level variables are indicated by upper- and lower-case letters respectively.

Table 2

Explanatory variables, symbols used to indicate each variable and the expected sign of the estimated regression coefficients

PANEL A: MARKET-WIDE VARIABLES		
Variable	**Symbol**	**Predicted Sign**
Equity Market Return	EMR_t	-
Change in Market-Wide I.E.V.	ΔIEV_t	+
Change in Spot Rate	ΔR_t^5	-
Change in Yield Curve Slope	$\Delta SLOPE_t^{10-2}$	+ or -
Change in Exchange Rate	ΔXR	+
MKT Factor	MKT_t	-
SMB Factor	SMB_t	-
HML Factor	HML_t	-
PANEL B: COMPANY-LEVEL VARIABLES		
Stock Return	ret_t^i	-
Stock Momentum	mom_t^i	-
Change in I.E.V.	Δiev_t^i	+
Change in Illiquidity	Δliq_t^i	+

3.3 BOND SAMPLE

The analysis done in this research is based on South African data for the period 1 October 2007 to 30 April 2018, which is approximately 11 years. It is similar to the length of the time interval used in most prior studies. Collin-Dufresne et al. (2001) considered a period from the late 80's to the late 90's (approximately 10-years), Avramov et al. (2007) used observations between September 1990 and January 2003 (approximately 12-years). The paper of Radier et al. (2016), which is also based on South African data considered a 9-year period from 2005–2013.

Daily bond data that was traded on the Bond Exchange of South Africa (BESA) was obtained from the JSE for the period under consideration. It yielded in 690 bond issues. Further, the corresponding equity data was obtained from IRESS for the period under consideration.

In filtering the data, the same approach is followed as what was initially applied by Collin-Dufresne et al. (2001) and later by both Avramov et al. (2007) and Radier et al. (2016). By doing this it will be comparable to prior studies.

Only bonds with available corresponding equity data were included in the final bond sample. Therefore, the first step in the filtering process was to match the bond and equity datasets with the unique ticker of the issuing company. The sample is then restricted to only corporate vanilla bonds (non-callable, non-puttable, non-convertible, no sinking fund provision and with a fixed coupon rate). This reduced the bond sample from 690 to 390 different bonds issues with a remaining 36,140 available monthly observations.

The next step was to remove the monthly observations for which there were no monthly credit spread changes available. This decreased the bond sample to 4,061 observations.

The final step in the filtering criteria applied by various previous studies in filtering the bond sample is that a bond must have at least 25 monthly trader credit spread quotes for the period under consideration. For example, in Collin-Dufresne et al. (2001) for a bond to enter the final sample, it must have at least 25 monthly trader credit spread quotes for the July 1988 to December 1997 (113 months). Thus, they require that there needs to be a portion of at least 22.14% ($\frac{25}{113} \times 100$) of monthly trader credit spread quotes available with respect to the full time period under consideration.

The illiquidity measure used in this research is constructed in such a way that it will take on a value close to 1 if the bond is very illiquid or a value close to 0 if a bond is traded on a more regular basis during a specific month. To be in accordance to what was applied by Collin-Dufresne et al. (2001) the top 25% of the illiquid monthly observations were removed from the bond sample. Thus, all monthly credit spread observations with an illiquidity measure of less than 0.75 were included in the final bond sample. The final bond sample consisted of 390 bond issues with 2,020 monthly observations.

3.3.1 Control Variables

For the ease of analysis each monthly observation is assigned to a leverage group based on the company's leverage ratio (Collin-Dufresne et al., 2001). In Collin-Dufresne et al. (2001) the six leverage groups were constructed in such a way that it approximately replicate the bottom four quintiles and top two deciles of the final bond sample. To comply with this the following leverage groups were constructed: Under 47.5 percent, 47.5 to 60.833 percent, 60.833 to 74.1667 percent, 74.1667 to 87.5 percent, 87.5 to 88.5 percent, and 88.5 percent or more.

The leverage ratio applied by Collin-Dufresne et al. (2001):

$$Leverage\ Ratio = \frac{Book\ Value\ of\ Debt}{Market\ Value\ of\ Equity + Book\ Value\ of\ Debt} \tag{3.11}$$

Since the availability of the information of the variables used in equation 3.11 is not readily available, the following leverage ratio is derived that will be applied in this research.

$$Leverage\ Ratio = \frac{Book\ Value\ of\ Debt}{Market\ Value\ of\ Equity + Book\ Value\ of\ Debt}$$

$$= \frac{Book\ Value\ of\ Debt}{Book\ Value\ of\ Debt}\left[\frac{1}{\frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Debt} + 1}\right]$$

$$= \left[\frac{1}{\left(\frac{Book\ Value\ of\ Debt}{Market\ Value\ of\ Equity}\right)^{-1} + 1}\right]$$

Consider the term $\frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Debt}$.

The following financial ratios were obtained from IRESS for the full sample period:

i. Price of Equity-to-Book Value of Equity
ii. Book Value of Debt-to-Book Value of Equity

$$\left(\frac{Price\ of\ Equity}{Book\ Value\ of\ Equity}\right) \times \left(\frac{Debt}{Book\ Value\ of\ Equity}\right)^{-1} = \frac{Price\ of\ Equity}{Book\ value\ of\ Debt} \tag{3.12}$$

By substituting equation 3.8, yields:

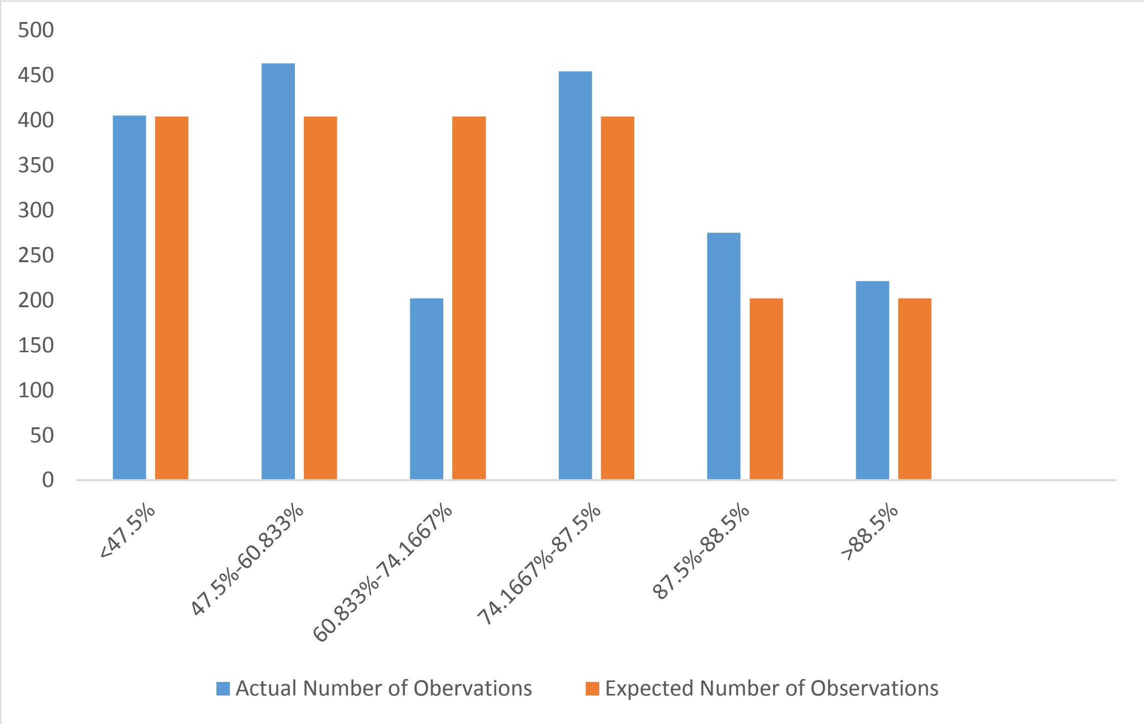
$$Leverage\ Ratio = \left[\frac{1}{\left(\frac{Price\ of\ Equity}{Book\ Value\ of\ Equity}\right) \times \left(\frac{Debt}{Book\ Value\ of\ Equity}\right)^{-1} + 1}\right] \tag{3.13}$$

The final ratios used in equation 3.13 can only be obtained on an annual basis when the financial results of the companies are reported. The data used in equation 3.11 were obtained on a timelier basis.

A comparison between the actual and expected number of observations in each leverage group when replicating the bottom four quintiles and top two deciles of the final bond sample can be seen in figure 2. The actual and expected number of observations follow each other closely in each leverage group, except for the 60.833%-74.1667% leverage group where the difference is approximately 200 observations. This lower than expected number of observations occur due to the clustering of observations in the final bond sample. Since, yearly data is used to calculate the different leverage ratios this resulted in clustering of observations close to certain leverage ratios.

Figure 2

Comparison of the actual number of observations and the expected number of observations in each leverage group.



3.3.2 Summary Statistics

Within each leverage group the observations are further subdivided according to time to maturity. Radier et al. (2016) used the following groups: Short (less than 5 years), Medium (5 to 10 years) and Long (more than 10 years). Radier et al. (2016) considered daily data where this paper uses monthly data so by using their construction will result that the regression analysis will be insufficient in the long maturity group since there will not be enough observations. This research adjusted the maturity groups marginally to increase the number of monthly observations in the long maturity group. The following groups were constructed: Short (less than 4 years), Medium (4 to 8 years) and Long (more than 8 years). Table 2 presents the descriptive statistics of the credit spreads for the entire bond sample. As expected, the average credit spreads increase with the leverage groups for the bottom three leverage groups. Then there is an unexpected drop in the average credit spread in the fourth leverage group but that forms a base for the expected increase in the top two leverage groups. Radier et al. (2016), which is the only other paper conducted in the context of the South African market, also experienced a similar unexpected drop in the average credit spreads in some of their subsamples with a decrease in the credit rating. This is a recommendation for future research to attempt to come with a solution for this unexpected behaviour of the average credit spreads as the leverage ratio of the issuing company increases. In general, the average credit spreads increase as the time to maturity increases which is also according to what is expected.

Given that all the variables and the final bond sample that will be used in the analysis is fully defined the next chapter will proceed by analysing this data in attempt to determine how well these identified potential determinants explains monthly credit spread changes in the context of the South African market.

Table 3

Descriptive statistics of the credit spreads (bps) of the final corporate bond sample, October 2007- April 2018

PANEL A: ALL MATURITIES						
	Groups Based on Leverage Ratio					
Statistic	**<47.5%**	**47.5%-60.833%**	**60.833%-74.1667%**	**74.1667%-87.5%**	**87.5%-88.5%**	**>88.5%**
Number of Observations	405	463	185	471	275	221
Mean	170.84	189.16	198.95	123.60	135.62	154.57
Standard Deviation	70.55	56.08	50.08	43.56	40.98	36.76
Range	360.90	375.00	242.00	437.19	208.60	171.14
PANEL B: SHORT MATURITIES ONLY						
Number of Observations	243	291	117	194	133	72
Mean	164.15	178.51	197.76	94.68	111.86	138.43
Standard Deviation	76.13	59.09	48.44	43.75	34.96	44.97
Range	360.90	230.00	242.00	437.19	176.93	34.00
PANEL C: MEDIUM MATURITIES ONLY						
Number of Observations	147	156	61	179	104	111
Mean	184.04	209.30	203.46	131.57	150.07	155.21
Standard Deviation	62.13	62.87	54.37	30.88	29.82	25.12
Range	294.00	311.00	175.00	126.83	146.75	121.08
PANEL D: LONG MATURITIES ONLY						
Number of Observations	15	16	24	81	38	38
Mean	149.92	186.43	198.44	162.23	179.25	187.05
Standard Deviation	10.09	33.09	28.91	30.88	32.07	23.54
Range	35.00	102.30	102.75	126.83	152.00	85

CHAPTER 4
METHODOLOGY AND RESULTS

Chapter 4 begins by providing a summary of the methodology and results of the most important papers which this research is based on. The purpose of this section is to highlight the origin of the different ideas used when analyzing the data. The next section provides a detailed discussion on the methodology used to analyse the data. It also includes a complete interpretation of the results of the different calculations. This chapter is concluded where the results are compared to findings of prior studies.

4.1 OTHER EMPIRICAL FINDINGS

Collin-Dufresne et al. (2001) specifically used structural models of default as motivation to identify the different potential determinants of credit spreads. Except for the interest rates used in structural models, all the other variables are firm specific. Collin-Dufresne et al. (2001) used each bond's leverage ratio as the control variable in their multiple linear regression analysis. Within each of these leverage groups the observations were further divided into three different maturity groups. After analysing the data, Collin-Dufresne et al. (2001) observed that variables suggested by structural models are not enough to explain changes in credit spreads. To have a better understanding in the nature of the remaining variation they applied principal components analysis on the residuals of the multivariate regression where the result revealed that over 75 percent of the variation is due to the first component. This result indicates that credit spread changes contain a large systematic component that lies outside of the structural model framework. Collin-Dufresne et al. (2001) also concluded that market-wide factors are much more important than firm-specific factors in determining credit spread changes and they have shown that liquidity (as measured by trading volume and bid-ask spread) can have major effects on bond prices.

Avramov et al. (2007) have expanded on the study of Collin-Dufresne et al. (2001) by including market-wide variables additional to company-level variables in their regression analysis and the also conducted their analysis on high-yield bonds as well. Interesting new variables which have been incorporated by Avramov et al. (2007) were the change in market-wide idiosyncratic equity volatility for market-wide variables and stock return momentum and change in idiosyncratic equity volatility for company-level variables.

Avramov et al. (2007) applied various regression equations in their multiple linear regression analysis. They found that a combined set of the identified market-wide variables and company-level variables explain changes in credit spreads more accurately as the grade of the corporate bonds increases. Further, they noticed by including Fama-French factors at the expense of equity market return (since equity market return is highly correlated with the MKT factor) in their model the adjusted R-squared increased from 53.44% to 54.72%. They concluded that variables motivated by structural models explain credit spreads changes successfully.

Radier et al. (2016) investigated how much of the variation in daily credit spread changes is explained by determinants motivated by structural models in the context of the South African market for the period from 2005 to 2013. This paper was innovative in the sense that it investigated daily credit spread changes in an emerging market country that uses the inflation targeting framework with the market size and liquidity relatively lower compared to developed markets. With Radier, et al. (2016) there are two important differences in comparison to most prior studies. Firstly, the dependent variable (credit spread changes) in the regression equation and its corresponding independent variables are all daily movements and not monthly movements. Secondly, they used the R-squared and not the adjusted R-squared to quantify how successful the determinants describe daily variation in the credit spread changes.

Radier et al. (2016) used credit ratings of the bond issuers as control variables. For their multivariate regression analysis on the full sample period (2005-2013) they have reported a R-squared of 0.012 for the highest rated bonds to 0.621 for the lowest grade bonds. From the results of their analysis they conclude that the suggested determinants namely change in the spot rate, changes in the slope of the yield curve and change in volatility are indeed significant in explaining the variation in daily credit spread changes.

4.2 MULTIPLE LINEAR REGRESSION ANALYSIS

For each bond *i* at *time t* with change in credit spread, ΔCS_t^i , regression equation 4.1 is estimated.

$$\Delta CS_t^i = \alpha + EMR_t + \Delta IEV_t + \Delta R_t^5 + \left(\Delta R_t^5\right)^2 + \Delta SLOPE_t^{10-2} + ret_t^i + mom_t^i + \Delta iev_t^i + \Delta liq_t^i + \varepsilon_t^i \quad (4.1)$$

Equation 4.1 is applied within each leverage group for short-, medium-, long-, and all maturities subsamples.

Tables 4-7 presents the findings for short-, medium-, long-, and all maturities subsamples.

4.2.1 Results

Each variable will be interpreted and discussed individually when equation 4.1 is applied on all maturities to make a detailed conclusion about the effect of these identified variables on monthly credit spread changes. When equation 4.1 is applied across the three different maturity groups the results will be discussed in general in order to make a conclusion about how the credit spread changes in the different maturity groups are associated with these identified variables.

4.2.1.1 All Maturities

Most of the explanatory variables investigated have some ability to explain changes in credit spreads. Further, the signs of the estimated coefficients generally agree with theory. See summary of the main findings below.

Table 4 presents the results of all maturities for the full sample period 2007 to 2018.

i. Equity Market Return

Equity market return is statistically significant in most of the leverage groups, but especially in the bottom two (lowest risk) leverage groups. The estimated coefficients are negative, which is in support of the arguments of Altman and Kishore (1996). A return of one percent on the All Share Index is associated with a decrease of approximately 35 basis points for the lowest leverage group.

ii. Change in Market-Wide Idiosyncratic Equity Volatility

In general, the estimated coefficients have positive signs in most of the leverage groups as expected. For the 47.5%-60.883% leverage group is significant at a 1% significance level. In this leverage group a unit increase in the volatility will result in an increase of 35.26 basis points in the credit spreads. Two of the top three leverage groups have negative estimated coefficients which is in accordance with the arguments of Kwan's (1996) where he concluded that volatility is a significant driver of credit spread changes but reported a negative relationship.

From this it can be indeed concluded that change in market-wide idiosyncratic equity volatility have a significant influence on credit spread changes, but it is not obvious to make a conclusion about the direction in which the credit spread will change. To use a different market-wide idiosyncratic volatility estimate in future research will maybe help to answer this uncertainty.

iii. Change in 5-Year Spot Rate

It has negative signs in all the leverage groups, except for 74.1667%-87.5%. In this leverage group it has a positive coefficient and it is significant at a 1% significance level. Except for this leverage group the estimated coefficients ranges from -7.36 to -0.46. An increase of one percent in the 5-year spot rate will lead to a decrease of approximately 3 basis points in the credit spread. Which is an indication that it is not economically significant.

iv. Change in Spot Rate Squared (5-Year)

Across all the leverage groups the positive and negative signs of the estimated coefficients are approximately equally divided between them. It is statistically significant at two of the six leverage groups but with opposite signs. From these results it is challenging to make a conclusion on what the effect of the non-linear terms on monthly credit spread changes would be.

v. Change in Slope of the Yield Curve (10Y-2Y)

Change in the slope of the 10Y-2Y yield curve is supported by the two competing hypotheses. The lower leverage groups have positive estimated coefficients and is significant at a five percent significance level, which supports the argument of Avramov et al. (2007). An increase of one unit in the magnitude of the slope will yield in an increase of 5 basis points in the credit spread. For the higher leverage groups the estimated coefficients are mostly negative, but it is not statistically significant. From this can be concluded that for the low leverage groups (low risk) the change in the slope of the yield curve have a significant positive impact on the credit spreads.

vi. Stock Return

The estimated coefficients are negative in five out of the six leverage groups which is in support of theory. The only exemption is in the 74.1667%-87.5% leverage group where the sign of the estimated coefficient is positive and statistically significant at a 1% significance level. From this it is not obvious to make a conclusion about the direction in which the credit spread will change but it can indeed conclude that the stock return has a significant influence on credit spread changes.

vii. Stock Momentum

It has negative estimated coefficients across all the leverage groups as expected. In most of the leverage groups it is statistically significant at an 1% significance level. This is an indication that a positive stock return momentum will lead to a decrease in credit spreads. Avramov et al. (2007) established a strong link between credit rating and momentum in equity returns. These negative estimated coefficients support the argument since a positive stock momentum is related to an improvement in credit rating which will decrease the credit spread.

viii. Change in Idiosyncratic Equity Volatility

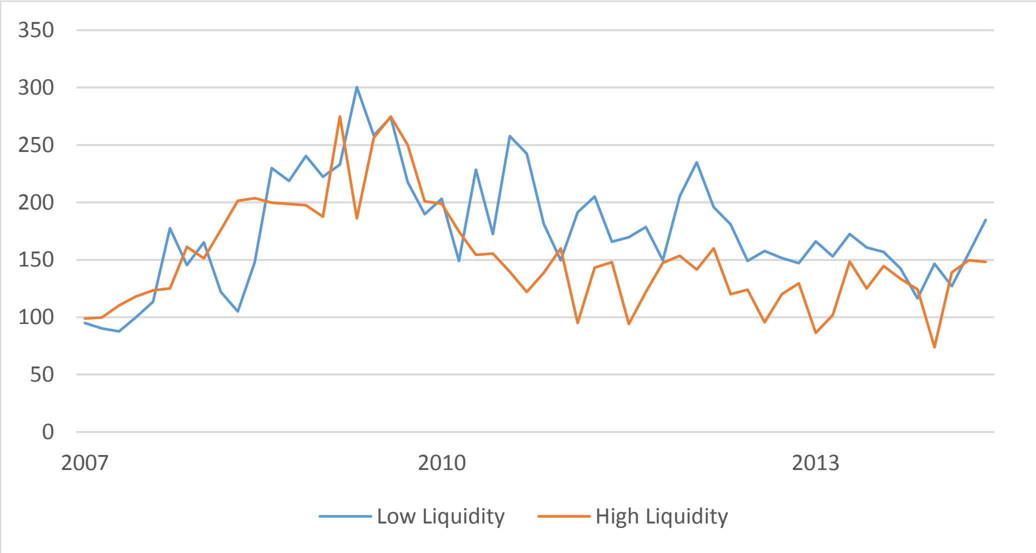
Change in idiosyncratic equity volatility have a positive predicted sign in only one leverage group, namely 74.1667%-87.5%. This is also the only leverage group where it is statistically significant at a 1% significance level. In the other groups where it has the unexpected negative coefficient it is not significant.

ix. Change in Illiquidity

The estimated coefficients are positive but not statistically significant. Voss (2012) argues that the liquidity factor has a higher impact on the credit spread for non-investment grade bonds and emerging markets, where the outstanding volumes are small. This argument is supported by the argument that investors bear a higher risk because of the market's incapability of trading quickly, which consequently leads to higher credit spreads. Figure 3 is a presentation of the average credit spreads on low liquidity and high liquidity bonds in the final sample for the period under consideration, which is indeed in support of the arguments of Voss (2012). It will be interesting to see effect a different illiquidity measure will have on the significance of the coefficients. This is ideal for future research.

Figure 3

Credit Spread (bps) comparison between low liquidity and high liquidity bonds



4.2.1.2 Short-, Medium-, and Long-Maturities

For short maturities the stock return, stock return momentum and equity market return are statistically significant with the expected negative sign across most leverage groups. From this can be concluded that a positive return in these variables will narrow the credit spreads for short maturities. The signs of the estimated coefficients are approximately equally divided between for the longer maturity groups. In these groups if the estimated coefficient is negative as expected then it is statistically significant where the unexpected positive estimated coefficients didn't carry any statistical significance. To conclude, these three variables are indeed negatively related to credit spread changes as expected and is statistically significant across all three maturity groups.

In general, the change in idiosyncratic equity volatility at both company- and market-wide level for across all three maturities are statistically significant with the expected positive sign. The only exceptions are that the coefficients that are negative and statistically significant for market-wide idiosyncratic volatility in the highest leverage group for medium maturities and for the 74.1667%-87.5% leverage group for long maturities. This is in accordance to Kwan's (1996) which found that equity volatility is a significant driver of credit spread changes but instead reported a negative relationship, which is in contradiction with Merton (1974). In general, from the empirical results an increase in idiosyncratic equity volatility will lead to an increase in credit spreads.

The coefficients of the change in the 5-year spot rate are mostly negative across the shorter maturity groups. A large portion of the coefficients in the long maturity group are positive which is in contradiction with Longstaff and Schwartz (1995), but none of them are statistically significant. The only exception is the 74.1667%-87.5% leverage group for short maturities where the estimated coefficient is positive and statistically significant. This indicates that the credit spread will increase with an increase in the interest rates. This relationship is not supported by any theoretical and empirical literature. Radier et al. (2016), which based on South African data, also found this positive relationship in some of their subsamples.

For short- and medium-maturities the squared value of the change in the 5-year spot rate are statistically significant but with opposite estimated signs. Collin-Dufresne et al. (2001) had similar findings. Radier et al. (2016) also found that non-linear interest rate terms are statistically significant. From this can be concluded that the squared value of the change in the 5-year spot rate is indeed significant but it is unclear in which direction it affects credit spread changes. A negative estimated coefficient is an indication that an increase in the spot rate will always result in a decrease in credit spreads where a positive sign implies that there is a barrier and with an increase in the spot rate beyond that barrier will not result in a further reduction in credit spreads. For long maturities this variable is not statistically significant.

For the change in slope of the yield curve (10Y-2Y) across the three maturity groups the positive and negative signs are approximately equally distributed between them. This is indeed in support of the two competing hypotheses which states that change in slope of the yield curve is significant in explaining credit spread changes but inconclusive about the sign.

For change in illiquidity the estimated coefficients are positive as expected but not statistically significant across all maturity groups.

Table 4

Market-wide and company-level determinants of credit spread changes by leverage group for all maturities.

ALL MATURITIES						
	Groups Based on Leverage Ratio					
Variable	**<47.5%**	**47.5%-60.833%**	**60.833%-74.1667%**	**74.1667%-87.5%**	**87.5%-88.5%**	**>88.5%**
Intercept	-1.48	-0.73	-1.16	0.07	-1.35	-0.17
	-2.41*	-0.94	-1.18	0.11	-2.38*	-0.23
Equity Market Return	-34.64	-74.17	-10.39	-42.99	15.91	-5.88
	-2.80**	-4.23***	-0.50	2.17*	1.04	-0.34
Change in Market-Wide I.E.V.	12.76	35.26	21.73	-15.86	2.57	-9.28
	1.17	2.60**	1.44	-1.82(.)	0.23	-0.65
Change in Spot Rate (5Y)	-3.73	-7.36	-3.90	5.90	-3.36	-0.47
	-1.51	-2.69**	-0.95	2.98**	-1.68(.)	-0.15
Change in Spot Rate Squared (5Y)	5.58	9.39	-3.87	-0.97	-10.78	1.22
	1.21	1.84(.)	-0.48	-0.29	-3.49***	0.31
Change in Yield Curve Slope(10Y-2Y)	0.66	4.92	10.51	-3.87	1.20	-2.54
	0.35	2.06*	3.01*	-1.23	0.55	-1.02
Stock Return	-16.93	-2.42	-5.40	97.32	-17.51	-20.64
	-2.09*	0.32	-0.55	10.07***	-1.70(.)	-1.57
Stock Momentum	-9.16	-25.42	-0.48	-37.96	-21.99	-2.93
	-1.90(.)	-4.62***	-0.09	-5.98***	-3.53***	-0.37
Change in I.E.V.	-3.05	-0.03	-8.47	37.91	-13.51	-9.90
	-0.53	-0.01	-1.41	4.06***	-2.29*	-1.08
Change in Illiquidity	-3.81	1.44	4.69	3.45	0.17	2.77
	-1.10	0.35	0.81	1.00	0.05	0.64
Multiple R-Squared	**0.07201**	**0.1127**	**0.0757**	**0.2884**	**0.1359**	**0.03409**
Adjusted R-Squared	**0.05087**	**0.09504**	**0.03238**	**0.274**	**0.1066**	**-0.007113**

Significant Codes: (.) p<0.1, * p<0.05, ** p<0.01, *** p<0.001; Correct sign: highlighted values

Table 5

Market-wide and company-level determinants of credit spread changes by leverage group for short maturities only.

SHORT MATURITIES ONLY						
	Groups Based on Leverage Ratio					
Variable	**<47.5%**	**47.5%-60.833%**	**60.833%-74.1667%**	**74.1667%-87.5%**	**87.5%-88.5%**	**>88.5%**
Intercept	-1.97	0.07	-1.92	0.77	-1.27	3.85
	-2.13*	0.07	-1.24	0.65	-1.29	1.99(.)
Equity Market Return	-39.96	-75.93	-29.44	-48.46	31.11	37.78
	-1.93(.)	-3.61***	-0.93	-1.34	1.16	1.11
Change in Market-Wide I.E.V.	6.32	29.31	27.94	-19.73	23.63	-16.56
	0.42	1.76(.)	1.13	-1.27	1.21	-0.43
Change in Spot Rate (5Y)	-3.38	-7.22	-9.87	11.64	-6.68	-7.28
	-0.98	-2.25*	-1.22	3.34**	-1.84(.)	-0.75
Change in Spot Rate Squared (5Y)	7.86	-3.37	9.74	-7.70	-15.78	-0.08
	1.15	-0.56	0.55	-1.46	-3.14**	-0.01
Change in Yield Curve Slope(10Y-2Y)	-0.002	16.15	15.42	-11.32	1.97	-8.40
	-0.001	5.76***	2.78**	-2.04*	0.50	-1.71(.)
Stock Return	-24.86	4.00	-3.33	136.14	-31.36	-71.73
	-2.18*	0.52	-0.24	8.60***	-1.82(.)	-2.56(*)
Stock Momentum	-18.95	-22.25	1.47	-73.71	-33.00	30.88
	-2.81**	-3.50***	0.18	-6.87***	-3.14**	1.64
Change in I.E.V.	-1.73	-3.98	-11.36	51.89	-14.80	-9.00
	-0.21	-0.72	-1.27	3.94***	-1.42*	-0.47
Change in Illiquidity	-4.77	0.18	4.89	5.58	-2.10	9.40
	-0.94	0.04	0.52	0.86	-0.37	0.98
Multiple R-Squared	**0.1086**	**0.1718**	**0.1214**	**0.4922**	**0.2408**	**0.1562**
Adjusted R-Squared	**0.07414**	**0.1453**	**0.04754**	**0.4674**	**0.1853**	**0.03375**

Significant Codes: (.) p<0.1, * p<0.05, ** p<0.01, *** p<0.001; Correct sign: highlighted values

Table 6

Market-wide and company-level determinants of credit spread changes by leverage group for medium maturities only.

MEDIUM MATURITIES ONLY						
	Groups Based on Leverage Ratio					
Variable	**<47.5%**	**47.5%-60.833%**	**60.833%-74.1667%**	**74.1667%-87.5%**	**87.5%-88.5%**	**>88.5%**
Intercept	-0.74	-1.87	-1.37	-1.91	-2.60	-2.11
	-1.03	-1.67(.)	-1.19	-3.00**	-3.55***	-2.86**
Equity Market Return	-33.61	-42.36	0.03	7.98	-2.47	1.03
	-2.29*	-1.50	0.001	0.37	-0.12	0.04
Change in Market-Wide I.E.V.	22.97	44.43	-1.69	2.67	-14.23	-29.58
	1.60	2.32*	-0.11	0.32	-0.98	-2.29*
Change in Spot Rate (5Y)	-4.94	-7.28	1.15	1.45	0.27	-0.20
	-1.47	-1.82(.)	0.28	0.72	0.10	-0.07
Change in Spot Rate Squared (5Y)	4.51	30.69	1.10	8.20	4.56	5.52
	0.81	4.12***	0.16	2.32*	0.87	1.32
Change in Yield Curve Slope(10Y-2Y)	2.17	-17.22	2.42	-0.14	-3.85	4.45
	1.00	-4.24***	0.61	-0.04	-1.30	1.27
Stock Return	2.95	-28.75	16.40	26.09	-32.17	10.53
	0.28	-2.45*	1.18	2.34	-2.18*	0.70
Stock Momentum	12.88	-38.50	0.22	5.21	-5.03	-10.57
	2.06*	-4.46***	0.03	0.78	-0.59	-1.27
Change in I.E.V.	-6.75	-7.12	-7.45	5.85	-7.93	-7.92
	-0.99	-0.76	-0.87	0.74	-1.05	-0.72
Change in Illiquidity	-2.33	3.65	-2.03	2.21	4.52	-1.63
	-0.58	0.57	-0.34	0.70	1.09	-0.35
Multiple R-Squared	**0.0986**	**0.3708**	**0.04977**	**0.09637**	**0.106**	**0.09262**
Adjusted R-Squared	**0.03939**	**0.332**	**-0.1179**	**0.04824**	**0.02035**	**0.01176**

Significant Codes: (.) p<0.1, * p<0.05, ** p<0.01, *** p<0.001; Correct sign: highlighted values

Table 7

Market-wide and company-level determinants of credit spread changes by leverage group for long maturities only

LONG MATURITIES ONLY						
	Groups Based on Leverage Ratio					
Variable	**<47.5%**	**47.5%-60.833%**	**60.833%-74.1667%**	**74.1667%-87.5%**	**87.5%-88.5%**	**>88.5%**
Intercept	0.47	-3.30	2.58	-1.79	-0.54	-0.62
	0.33	-0.62	0.71	-1.68(.)	-0.77	-0.37
Equity Market Return	1.87	-4.72	18.65	-23.09	7.56	-103.31
	0.06	0.06	0.15	-0.85	0.45	-1.89(.)
Change in Maket-Wide I.E.V.	-44.84	148.57	17.00	-36.79	-2.28	38.86
	-1.33	1.11	0.29	-2.49*	-0.16	1.01
Change in Spot Rate (5Y)	0.97	19.33	7.79	3.98	0.17	-0.07
	0.23	0.53	0.41	1.39	0.09	-0.01
Change in Spot Rate Squared (5Y)	2.65	175.64	-36.44	8.10	4.28	-3.33
	0.27	1.78	-1.17	0.98	0.76	-0.49
Change in Yield Curve Slope(10Y-2Y)	-1.10	-17.74	0.92	-3.24	0.06	19.40
	-0.16	-0.98	0.06	-0.60	0.02	1.70(.)
Stock Return	9.34	-130.33	3.58	20.44	-1.62	18.21
	.42	-1.09	0.03	1.15	-0.13	0.59
Stock Momentum	-19.46	6.27	35.54	0.54	-1.99	-38.65
	-1.36	0.12	1.60	0.06	-0.26	-2.18*
Change in I.E.V.	-1.42	44.74	-18.26	1.17	0.37	-5.08
	-0.08	0.95	-0.76	0.09	0.05	-0.22
Change in Illiquidity	7.08	-29.85	31.83	4.27	6.81	-6.26
	0.66	-0.96	1.59	0.70	1.90	-0.67
Multiple R-Squared	**0.4901**	**0.866**	**0.4517**	**0.1545**	**0.138**	**0.2681**
Adjusted R-Squared	**-0.4278**	**0.6651**	**0.09917**	**0.04733**	**-0.139**	**0.032866**

Significant Codes: (.) p<0.1, * p<0.05, ** p<0.01, *** p<0.001; Correct sign: highlighted values

4.3 THE EFFECT OF INCORPORATING FAMA-FRENCH FACTORS AT THE EXPENSE OF EQUITY MARKET RETURN

For each sample *bond i* at *time t* with change in credit spread, ΔCS_t^i , regression equation 4.2 is estimated.

$$\Delta CS_t^i = \alpha + \Delta IEV_t + \Delta R_t^5 + \left(\Delta R_t^5\right)^2 + \Delta SLOPE_t^{10-2} + MKT + SMB + HML + ret_t^i + mom_t^i + \Delta iev_t^i + \Delta liq_t^i + \varepsilon_t^i \tag{4.2}$$

As executed by Avramov et al. (2007) the equity market return variable in equation 4.1 is substituted by the three Fama-French factors, since the MKT-factor is highly correlated with the equity market return.

Equation 4.2 is applied within each leverage over the all maturities subsample only. Table 8 presents the findings.

4.3.1 Results

Across the six leverage groups the adjusted R-squared ranges between 0.00% to 27.27% with equation 4.2. In the case of equation 4.1 the adjusted R-squared ranges between 0.00% and 27.4%. The average adjusted R-squared (calculated as the arithmetic mean) across all six leverage groups for equation 4.1 and equation 4.2 is 9.31% and 9.43% respectively. This slight increase in the adjusted R-squared is in accordance with the findings of Avramov et al. (2007). This evidence shows that our variables included in the model explain essentially all the systematic variation and that most of the explanatory power of the three Fama-French factors is already absorbed in the model.

Further, in support of the argument that the MKT-factor and equity market return is highly correlated the expected sign of the estimated coefficients are the same and significant at the same significance level across the corresponding leverage groups, except for the 87.5%-88.5% leverage group. The estimated coefficient of the MKT-factor is negative as expected and positive in the case if equity market return. In both cases they are not statistically significant

Table 8

Incorporating Fama-French factors at the expense of equity market return for all maturities.

ALL MATURITIES						
	Groups Based on Leverage Ratio					
Variable	**<47.5%**	**47.5%-60.833%**	**60.833%-74.1667%**	**74.1667%-87.5%**	**87.5%-88.5%**	**>88.5%**
Intercept	-1.44	-0.43	-1.27	-0.20	-1.22	-0.11
	-2.31*	-0.54	-1.21	-0.27	-1.97*	-0.14
Change in Market-Wide I.E.V.	11.67	36.41	21.17	-16.85	3.27	-8.09
	1.07	2.68**	1.38	-1.92(.)	0.29	-0.56
Change in Spot Rate (5Y)	-4.77	-8.47	-3.89	6.17	-3.90	-1.10
	-1.92(.)	-3.01**	-0.92	2.88**	-1.93(.)	-0.35
Change in Spot Rate Squared (5Y)	4.38	8.47	-3.53	-0.30	-11.76	-0.25
	0.95	1.65(.)	-0.43	-0.09	-3.41***	-0.06
Change in Yield Curve Slope(10Y-2Y)	-0.79	2.92	10.89	-3.85	1.41	-3.47
	-0.40	1.14	2.95**	-1.22	0.52	-1.29
MKT	-56.08	-101.68	-4.36	-27.59	-9.80	-23.64
	-3.23**	-4.02***	-0.16	-1.00	-0.45	-1.04
SMB	-19.75	-50.80	13.21	25.88	-19.64	-25.74
	-0.93	-1.75(.)	0.35	0.93	-0.87	-0.96
HML	-34.64	21.16	-1.52	-9.27	-21.81	-17.73
	-1.65(.)	0.73	-0.06	-0.42	-1.09	-0.71
Stock Return	-12.29	2.48	-5.46	96.24	-6.39	-16.21
	-1.48	0.29	-0.56	9.49***	-0.54	-1.17
Stock Momentum	-10.70	-25.16	-0.07	-38.00	-22.89	-5.10
	-2.21*	-4.57***	-0.01	-5.98***	-3.67***	-0.64
Change in I.E.V.	-3.67	1.19	-8.21	36.71	-13.91	-9.85
	-0.64	0.23	-1.35	4.80***	-2.30*	-1.07
Change in Illiquidity	-3.44	2.26	4.53	3.21	0.13	3.56
	-1.00	0.54	0.77	0.92	0.04	0.82
Multiple R-Squared	**0.08592**	**0.1188**	**0.07661**	**0.2904**	**0.1481**	**0.04446**
Adjusted R-Squared	**0.06033**	**0.09735**	**0.02315**	**0.2727**	**0.1125**	**-0.005836**

4.4 PRINCIPAL COMPONENTS ANALYSIS

In general, the determinants used in the multiple linear regression analysis of equation 4.1 are both statistically and economically significant in explaining the monthly variation in credit spread changes. However, the adjusted R-squared ranges between 0.00%-66.51% across all subsamples considered. To have a better understanding of the nature of the remaining variation principal components analysis is applied on the residuals of equation 4.1.

This is done by firstly combining the top two leverage groups together (i.e. 87.5%-88.5% and >88.5%) into a single leverage group. The final bond sample is therefore subdivided into five leverage groups. Within each of these leverage groups the observations were further subdivided according to time to maturity. The following groups were constructed: Short (less than 4 years), Medium (4 to 8 years) and Long (more than 8 years). By splitting the final bond sample accordingly yields in fifteen bins. To summarise, each of the five leverage group bins are further subdivided into another three bins according to the time to maturity of each observation. Equation 4.1 is applied across all these bins and the residuals were allocated to each of the fifteen bins. Within each bin the residuals were further grouped by the specific month of the observation. The average was taken over the residuals within each of these monthly groups. From this it was possible to use these average values and construct a matrix with a row for each month for the period under consideration (1 October 2007 – 30 April 2018) and fifteen columns (one for each bin). Principal component analysis was applied to this matrix. Table 9 is a representation of the first two principal components.

The purpose of the principal components analysis was to determine whether significant unexplained systematic variation remains in the residuals. The first principal component explains more than 20% of the variation in the residuals. Collin-Dufresne et al. (2001) noted that more than 75% of the variation was due to the fist component. From this can be deduced that the credit spread changes in this research contain a much smaller systematic component that lies outside the variables used in this model (equation 4.1). The second component explains another 20% of the remaining variation. This implies that approximately 40% of the variation in the residuals are explained by the first two principal components.

Table 9

First two principal components from the method of principal components analysis applied on the residuals to equation 4.1

		Principal Components	
Analysis Bins		**Equation (4.1) Residuals**	
Maturity	**Leverage**	**First**	**Second**
Short	Low	0.903103683	0.138245123
Short	2	-0.020032762	-0.016525296
Short	3	0.023019081	-0.090559554
Short	4	0.096355308	-0.971565020
Short	High	0.173331700	0.056361484
Medium	Low	0.003104168	-0.022870382
Medium	2	0.276388827	-0.107880658
Medium	3	0.029483708	-0.041520278
Medium	4	0.056675384	-0.090571556
Medium	High	0.238213871	-0.022135862
Long	Low	0.001123670	-0.002831147
Long	2	0.038845525	-0.005262136
Long	3	-0.067903770	-0.044754372
Long	4	-0.005922511	-0.012273719
Long	High	0.027575948	-0.023048474
Cum. % Explained by PC		**0.2169**	**0.4233498**
Avg. adj. R-Squared of Regression		**0.1253131111**	

CHAPTER 5
CONCLUSION

5.1 INTRODUCTION

The purpose of this paper was to predict monthly credit spread changes in the context of the South African bond market for the period from 2007 to 2018. During this period there was 690 bond issues in total. From these 690 bond issues, 390 different bonds with a total of 2,020 monthly observations qualified for the final bond sample.

This study is different from the only other South African paper authored by Radier et al. (2016) in several ways. Radier et al. (2016) examined a different time period, the determinants used in their regression analysis were explicitly inspired by the framework of structural models of default and they considered daily changes in credit spreads instead of monthly changes. An additional research question Radier et al. (2016) attempted to answer was regarding effect of the financial crisis during 2007-2009 on credit spread changes.

The final set of explanatory variables that is used in the regression analysis consists of company-level and market-wide variables. Some of these variables are explicitly motivated by structural models of default while the others are used by various previous studies. The method of stepwise regression (backward elimination) is used to identify the optimal variable selection from a whole collection of variables which are identified as possible determinants from prior studies.

5.2 SUMMARY OF MAIN FINDINGS

For all maturities the model explains at most 27.4% of the variation in monthly credit spread changes as measured by the adjusted R-squared. It very similar that was found by Collin-Dufresne et al. (2001) although additional determinants are incorporated in this paper and the regression analysis was also applied on high yield bonds as well. This compensates for the lack of liquidity and available data in the South African market versus the U.S. market. It is also demonstrated by incorporating Fama-French factors instead of equity market return in the model that it captures some of the systematic risk in credit spread changes. This was also confirmed by Avramov et al. (2007) which were conducted on U.S. markets.

When the regression is applied on the short maturity group it is observed that the adjusted R-squared ranges between 3.37% and 46.74%. Because of the number of observations in the short maturity group the findings in this group will be more compelling in comparison to the other two maturity groups. The adjusted R-squared ranges 0.00%-33.2% and 0.00%-66.51% for the medium- and long-maturity groups respectively.

It is difficult to draw a comparison between the observations in this paper and the findings in Radier et al. (2016) because of the above-mentioned differences. They also used the multiple R-squared instead of the adjusted R-squared to measure the amount of variation in the credit spread changes which is described in their model.

Most of the explanatory variables investigated have some ability to explain changes in credit spreads. Further, the signs of the estimated coefficients generally agree with theory. From the empirical findings it is clear that in some subsamples a portion of the monthly credit spread changes are indeed explained by the model where in others it is difficult to make a conclusion.

In addition, Collin-Dufresne et al. (2001) noted the existence of a strong latent factor in the unexplained variation that lies outside the structural model framework. This was an indication that credit spread changes are rather driven by market-wide variables instead of variables motivated by structural models. By including market-wide variables into the model reduced the existence of a strong latent factor substantially.

This finding appears to highlight a shortcoming of existing theoretical models of default risk.

5.3 FURTHER RESEARCH

Considering the weaknesses, strengths and limitations of the study, there are opportunities for future research to consider which will broader the research of credit spread. Due to the small sample size used in this paper it is difficult to make convincing conclusions about the ability of predicting monthly credit spread changes on South African corporate bond data. Future research needs to consider using a larger sample size. This can be done by extending the sample period or rather use shorter time intervals instead of monthly credit spread changes. Larger sample size would increase the robustness of the results.

Further, it would be interesting to use different methods (e.g. GARCH volatility estimates) or extending the time window for estimating the volatility. The Equally Weighted Moving Average Method with a time window of 30-days is used in this paper, which is very basic and can be inaccurate. This could make a significant difference since volatility is one of the key inputs of structural models.

One would expect that the credit spreads changes are more sensitive to the occurrence transactions because of the illiquidity of the South African market in comparison to developed markets. To get more clarity about this general assumption it would be interesting to incorporate the following two ideas in further studies. Firstly, use a more proven illiquidity measure than the one that was defined and was used in this paper. Secondly, because of the fairly long time-lapse between two consecutive transactions it would be interesting to calculate interpolated values for credit spread changes in-between actual transactions. This will also increase the number of observations in the final sample.

The leverage ratio used in this paper calculation is based on the annual financial statements of the issuing company, which is reported only once a year. To construct the leverage groups with more accuracy it would be beneficial to use or calculate a leverage ratio which is more relevant to the time of each observation in the final sample.

REFERENCES

Altman, Edward I., and Vellore M. Kishore, (1996). Almost everything you wanted to know about recoveries on defaulted bonds. *Financial Analysts Journal,* 52(6), 57-64.

Avramov, D., Jostova, G. and Philipov, A. (2007). Understanding changes in corporate credit spreads. *Financial Analysts Journal,* 63(2),90-105.

Bao, J., Pan., and Wang, J. (2011). The illiquidity of corporate bonds. *The Journal of Finance,* 66(3), 119-149.

Barnebeck Andersen, T., Malchow-Møller, N. and Nordvig, J. (2014). Inflation-Targeting, Flexible Exchange Rates and Macroeconomic Performance since the Great Recession. (Unpublished).

Boss, M. and Scheicher, M. (2002). The determinants of credit spread changes in the euro area. *BIS Papers,* 12:181-1999.

Brennan, Michael J., Chordia, T. and Subrahmanyam, A. (1998). Alternative Factor Specifications, Security Characteristics, and the Cross-Section of Expected Stock Returns. *Journal of Financial Economics*, 49(3),345-373.

Chen, L., Lesmond, D.A., and Wei, J. (2007). Corporate yield spreads and bond illiquidity. *The Journal of Finance,* 62(1), 119-149.

Campbell, J. Y., & Taksler, G. B. (2003). Equity volatility and corporate bond Yields. *The Journal of Finance, 58*(6), 2321-2350.

Capital, M., Authority. (2012). *Comparative study on African equity markets in 2011.* Retrieved November/22, 2014, from http://www.cma.or.ke/index.php?view=download&alias=402-issue-no-13-published-betweenoctober-a-december-2012&category_slug=newsletter&option=com_docman&Itemid=583.

Castagnetti, C. and Rossi, E. (2013). Euro corporate bond risk factors. *Journal of Applied Econometrics,* 28(3), 372-391.

Collin-Dufresne, P., Goldstein, R. S., and Martin, J. S. (2001). The determinants of credit spread changes. *The Journal of Finance, 56*(6), 2177-2207.

Elton, E. J., Gruber, M. J., Argrawal, D. and Mann, C. (2001). Explaining the Rate Spread on Corporate Bonds. *The Journal Finance,* 56(1), 247-277.

Fama, Eugene F., and Kenneth R. French, (1989). Business conditions and expected returns on stocks and bonds. *Journal of Financial Economics,* 25, 23-49.

Hull, J.C. (2012), *Options, Futures and Other Derivatives.* eighth edn. Pearson, Essex.

Kwan, S.H. (1996). Firm-specific information and the correlation between individual stocks and bonds. *Journal of Financial Economics,* 40(1), 63-80.

Jegadeesh, N., and Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *Journal of Finance*, 48(1), 35-91.

Jones, E. Philip, Scott P. Mason, and Rosenfeld, E. (1984). Contingent Claims Analysis of Corporate Capital Structures: An Empirical Investigation. *Journal of Finance*, 39(3),611-625.

JSE, B. (2013). Debt Market, South Africa. [Online]. Available: https://www.jse.co.za/trade/debt-market [06 October 2015].

Kim, J., Ramaswamy, K. and Sundaresan, S. (1993). Does Default Risk in Coupons Affect the Valuation of Corporate Bonds? A Contingent Claims Model. *Financial Management*, 22(3), 117-131.

Lawless, T. (2005). The development of the South African corporate bond market, relevance, impediments, prospects. *OECD Publishing,* 2005, 123-132.

Lin, M., Lucas Jr, H.C. and Shmueli, G. (2013). Research commentary-too big to fail: large samples and the p-value problem. *Information Systems Research,* 24(4), 906-917.

Liu, J.G. (2013). The bond market in South Africa: efficiency and investment Issues. Masters. University of Witwatersrand.

Longstaff, F. A., Mithal, S. and Neis, E. (2004). Corporate Yield Spreads: Default Risk or Liquidity. *The Journal of Finance,* 60(5), 2213-2253.

Longstaff, F.A. and Schwartz, E.S. (1995). A simple approach to valuing risky fixed and floating rate debt. *The Journal of Finance,* 50(3), 789-819.

McCauley, R., and Remolona, E. (2000). IV. Special feature: Size and liquidity of government bond markets. *BIS Quarterly Review*, 52-60*.*

Merton, Robert C., (1974). On the pricing of corporate debt: The risk structure of interest rates. *Journal of Finance,* 29, 449-470.

Radier, R., Majoni A., Njanike, K. and Kwaramba, M. (2016). Determinants of bond yield spread changes in South Africa. *African Review of Economics and Finance,* 8(2), 50-81.

Voss, J. (2012). Components of Credit Spreads and Their Importance. Retrieved February 25th from CFA Institute, https://blogs.cfainstitute.org/investor/2012/04/03/components of-credit-spreads-and-their-importance/

Welch, Ivo., (2004). Capital Structure and Stock Returns. *Journal of Political Economy*, 112(1), 106-131.

Yanzhi Wang, Lin Lin, Hsien-Chang Kuo, Jenifer Piesse. 2010. [Online]. Available: https://www.researchgate.net/figure/Firm-value-distribution-and-distance-to-default-Note-This-figure-is-from-Fig-81-in_fig1_226325920