SCHOOL OF
ECONOMICS AND
MANAGEMENT

The Credit Spread Puzzle in a Time of Uncertainty and Change

An Empirical Study of the Impact of Cyclical Variables on Corporate Bond Spreads Emitted by Swedish Real Estate Companies

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Abstract

The credit spread puzzle has long been a well-researched topic within the literature of fixed income securities, focusing on the factors contributing to credit risk to explain credit spreads. This study provides a new perspective on the subject by specifically examining corporate bonds issued by Swedish real estate companies during the years 2019 to 2023. It is investigated whether explanatory variables identified in prior research are applicable in this context and whether additional sector-specific variables can further explain the credit spreads. The selected variables are tested using a pooled OLS regression model. Our findings confirm that the established theoretical framework is applicable to this setting. Moreover, we identify two sector-specific variables, property acquisitions and vacancy rate, that show a statistically significant positive correlation with credit spreads, contributing new insights to the understanding of credit risk factors in the real estate sector.

Key words: The credit spread puzzle, credit spreads, credit risk, corporate bonds, real estate, cyclical variables, volatility, interest rates.

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Thank you so much.

1. Introduction

1.1 Background

The years 2019 to 2023 have been globally characterized by a tough economic state. Uncertainty and change due to geopolitical crises have created significant fluctuations in inflation and interest rates (Swedish National Bank, 2022). Historically, the property industry has remained resilient during uncertain times, as these companies are underpinned by real assets, which are regarded as “inflation-protected” (Avanza, 2023). On the other hand, The Swedish Financial Supervisory has, for several years, warned about financial risks associated with the Swedish property sector. Due to the combined characteristics of interest rate sensitivity and high leverage, the sector poses a direct threat to the financial stability (The Swedish Financial Supervisory Authority, 2023).

The real estate companies rely heavily on market financing through bonds and certificates (The Swedish Financial Supervisory Authority, 2023). The desire to finance their operations through bonds has increased dramatically in recent years, where the property sector accounted for more than half of the bonds in the Swedish bond market in 2022 (Andersson, 2022). However, the rising interest rates have led to higher borrowing costs for bonds, further elevating uncertainty in the sector. This has translated into higher credit risk premiums for corporate bonds emitted by real estate companies, which investors demand as compensation for the increased risks, also known as the credit spread (Andersson, 2022). Credit spreads have, for long, been a well-established and deeply researched topic within the literature of fixed income securities, due to the lack of a general consensus regarding the components of credit spreads. This problem is referred to as the credit spread puzzle.

What is understood about credit spreads is that they consist of factors that contribute to credit risk. These factors vary across different types of companies, industries and market conditions.

1.2 Problem statement

The aim of this study is to analyze the factors contributing to the credit spread of corporate bonds issued by listed Swedish real estate companies from 2019 to 2023. Building on existing research, this paper will conduct a pooled OLS regression analysis to examine bond-specific, firm-specific and market-specific variables and their correlations with the

credit spread. Additionally, this study will try to uncover new variables specific to the real estate sector, aiming to improve the understanding of credit spreads within this specific industry. The choice of this five-year period, marked by economic uncertainty and change, provides a unique opportunity to examine whether and in what ways the cyclical nature of the variables affects the result. Therefore, the research questions that this study seeks to answer are:

- Are explanatory variables, identified in previous studies of credit spreads, applicable to the Swedish real estate sector during the studied period?

and

- Are there additional, sector-specific, explanatory variables that can further explain the credit spread of bonds emitted by Swedish real estate companies?

1.3 Structure

The study begins with an institutional setting that provides the reader with a theoretical background and explanations of key concepts relevant to the study's purpose. Following this, a literature review is provided to summarize existing research on the topic up to the current date. Next, the method section describes the methodological approach of the study, the variables being examined, and the various tests conducted to verify the reliability of the model. Subsequently, the results are presented, followed by an analysis section that delves deeper into the findings and the implication of the result. Finally, the conclusion part is presented in order to revisit the initial problem statement and its conclusion, accompanied by suggestions for further research that could enhance relevance to the topic.

2. Institutional setting

This section demonstrates a theoretical background and explains the key concepts of the study to establish a foundation for the research questions.

2.1 The Swedish real estate market in a period of change

The real estate market is crucial for the economic stability of Sweden since the market is large and closely linked with the financial system. The sector is capital intensive and is therefore characterized by higher leverage ratios compared to other sectors. During 2019, the Swedish Financial Supervisory reported that property prices increased due to a long period of strong economic growth, low interest rates and good access to capital. Due to these favorable conditions, real estate companies increased their debts to finance acquisitions of properties and investments in new production. An increasing portion of real estate companies' borrowing occurred in the capital market through bonds (Swedish Financial Supervisory Authority, 2019). In 2022, the real estate companies accounted for about 50 percent of the corporate bond market (Andersson, 2022). By that time however, the favorable conditions of the economic upturn were over, significantly impacting the financial health of the real estate companies.

2.2 Corporate Bonds

A corporate bond is a financial tool used by companies to raise capital. It functions as a formal contract between the issuer, a corporation, and the investor. The contract obligates the issuer to pay a specified percentage of the bond's par value on designated dates outlined in the bond's terms. These payments are named as coupon payments. In addition to the coupon payments, the issuer must also repay the bond's full par or principal value at maturity (Fabozzi, Mann & Cohen, 2021). When setting the price for a bond, all future cash flows are discounted to a present value, using this equation:

$$P_0 = \sum_{t=1}^{n} \frac{CF_t}{(1+Y)^t} \qquad (Equation\ 1)$$

For already emitted bonds, the price (P_0), the predetermined cash flows (CF_t) and the maturity time (t), are known to the investor. Therefore, it is possible to determine the bond's yield, known as yield to maturity. The yield of a corporate bond consists of a risk-free interest

rate and an additional risk premium that compensates the investor for credit risk (Fabozzi, Mann & Cohen, 2021).

A corporate bond can be issued with either a fixed or floating coupon rate. The coupon payment of a bond with floating coupon rate changes when the reference rate changes (the risk-free interest rate), while the coupon payment of a fixed bond remains the same (The Swedish National Bank, 2013). This study will focus on fixed rate coupon bonds, where the Swedish swap rate is the fixed risk-free reference rate. An interest rate swap is a financial agreement enabling two parties to exchange interest payments for a set period of time. One party pays an interbank rent, typically the 3-month Stibor in Sweden, to the other, who in return pays a fixed interest rate throughout the contract´s term. The fixed rate, established at the start of the contract, is known as the swap rate (The Swedish National Bank, 2023).

Nowadays, banks are more restrictive, which has made it more difficult for companies to borrow money, especially those with low credit ratings. Consequently, corporate bonds have become a more popular financing method (Swedish National Bank, 2022).

2.3 Credit risk, Credit spreads and The Credit Spread Puzzle

The credit spread of a corporate bond with a fixed rate is defined as the difference in yield to maturity and a fixed risk-free interest rate. The spread emerges as investors demand compensation for the risk of holding default-prone debt rather than risk-free treasury bonds. The credit spread reflects both a default risk and a credit risk. Default risk and credit risk are often used interchangeably for describing the risk that a corporate bond entails. However, Foss (1995) highlights the importance of differentiating these concepts. Default risk is defined as the risk that the issuer of a fixed income security will be unable to make timely payments. On the other hand, credit risk is defined as the risk that the perceived credit quality of an issuer will change, although default is not necessarily a certain event (Foss, 1995). Thus, credit risk contains all possible risks that a company faces affecting their financial quality, which makes it complicated to quantify (Foss, 1995). This causes the problem referred to as the credit spread puzzle.

This study will refer to the credit spread as the gap between the yield to maturity of the bond and the Swedish swap rate as risk free rate. The relationship between the credit spread, swap rate and yield to maturity can be illustrated by diagram 1:

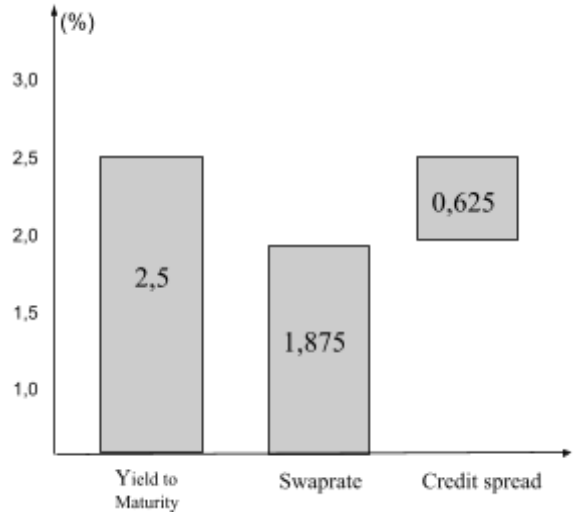

Diagram 1: A fictive illustration of the components of a bonds yield

2.4 Investment Grade and High Yield

Corporate bonds are classified into categories depending on the credit rating of the issuing company. Credit rating agencies, which are independent entities, evaluate a company's credit risk and assign ratings to financial products based on the security they provide to investors. The three most well-known and established rating agencies are Standard & Poor's, Moody's and Fitch. The ratings indicate a company's ability and willingness to meet its financial obligations fully and on time. Investors use these ratings as benchmarks to gauge the safety of their investments (S&P, 2022).

A company's credit rating determines whether its bonds are considered investment-grade or high yield. High-yield bonds are issued by companies with lower credit ratings, indicating that they carry a higher risk of default. Consequently, they offer higher interest rates to compensate investors for the increased risk and provide higher returns to attract investment.

A company's credit rating significantly influences their legitimacy and credibility as it directly affects their financing costs. A downgrade can lead to lower stock and bond prices, increased coupon rates, lost contracts, and mandatory security repurchases. On the other

hand, maintaining a particular credit rating provides several potential benefits for a company, such as increased ability to issue bonds, lower disclosure requirements, reduced investor capital reserve requirements and improved-third party relationships, thus increasing their access to capital as well as decreasing their cost of borrowing. The importance of credit rating to investors and other market participants has increased significantly, impacting an issuer´s access to and cost of capital, the structure of financial transactions, and the ability of fiduciaries and other particular investments (Kisgsen, 2007).

The repercussions of a low credit rating can be significant, affecting a company's overall business and growth prospects. Moreover, downgrades from investment grade to high yield occurs more often in economically unstable conditions, since the financial health of a firm can change rapidly.

	Moody´s	**Standard & Poor's**	**Fitch**
Investment Grade	Aaa Aa1, Aa2, Aa3 A1, A2, A3 Baa1, Baa2, Baa3	AAA AA+, AA, AA- A+, A, A- BBB+, BBB, BBB-	AAA AA+, A, A- A+, A, A- BBB+, BBB, BBB-
High yield	Ba1, Ba2, Ba3 B1, B2, B3 Caa Ca C	BB+, BB, BB- B+, B, B- CCC+, CCC, CCC- D	BB+, BB, BB- B+, B, B- CCC DDD DD D

Table 1: Credit rating classifications. Sources: Moody's, Standard & Poor's and Fitch (ND)

2.5 Liquidity Risk

When a company issues a bond, it generally partners with a bank or other financial institution to gauge investor interest. Once acquired on the primary market, directly at the point of issuance, it can then be traded on the secondary market, where banks and brokers act as intermediaries. Unlike markets for government or secured bonds, the secondary market lacks market makers, who ensure a willingness to buy or sell bonds at a set price. This absence makes corporate bonds relatively harder to trade (The Swedish national bank, 2020). Brigham & Ehrhardt (2008) define liquidity as the ability to sell a security quickly and at a price close to its value in a frictionless market. Consequently, an illiquid market requires a significant discount to ensure an immediate sale, thus introducing liquidity risk. Investors exposed to the

risk of being unable to sell their asset immediately without incurring losses demand higher yields as compensation (Brigham & Ehrhardt, 2008).

During periods of crisis, investors prefer safe securities, thus lowering the demand for corporate bonds. A decrease in demand directly decreases liquidity as the bond becomes harder to trade (Financial Supervisory Authority, 2023). Thus, liquidity is a cyclic variable that is affected by the economic state.

2.6 Capital structure

Some companies choose to finance their operations with a higher proportion of debt, while others fund their operations with a larger share of equity. These differences in financial strategy influence the nature and extent of the risks they face. Companies with higher debt exposure are more vulnerable to economic conditions and interest rate fluctuations. An increase in interest rates raises borrowing costs, directly impacting the company's profitability. Choosing an optimal capital structure is crucial, particularly in times of rising interest rates and business risks.

2.6.1 The Trade-Off Theory

The trade-off theory, developed by Myers (1984), examines how companies balance the pros and cons of different financing methods to determine their optimal capital structure. According to the theory, there are three main reasons why companies benefit from debt financing.

1. Companies enjoy tax advantages on interest payments, as interest expenses are deductible, which reduces taxable income.
2. Debt financing reduces risk for management and owners, since they do not need to invest as much of their own equity to finance operations. In case of bankruptcy, the shareholders of a limited company aren't held liable for debt repayment if company assets fall short. This increases owners' willingness to take risks, which can enhance profitability and returns.
3. Information asymmetry between owners and management diminishes with more debt financing, as lenders have strong incentives to monitor the company to ensure loan repayments. This oversight reduces management's inclination to pursue self-interest.

Furthermore, investor confidence often increases when credit institutions monitor a company.

Myers (1984) also acknowledges the disadvantages of debt financing, such as high interest costs and increased vulnerability to interest rate hikes. Companies must generate positive cash flows to cover interest and principal payments on its debt. A high level of debt also limits the company, as credit institutions are less likely to lend to highly indebted companies, which may hinder expansion opportunities or pose challenges in the face of unexpected expenses.

In light of this, Myers' (1984) theory argues that companies have an optimal balance between debt and equity financing. This optimal balance is not the same for all companies due to differences in factors such as tax rates, business plan risks, and future cash flow security.

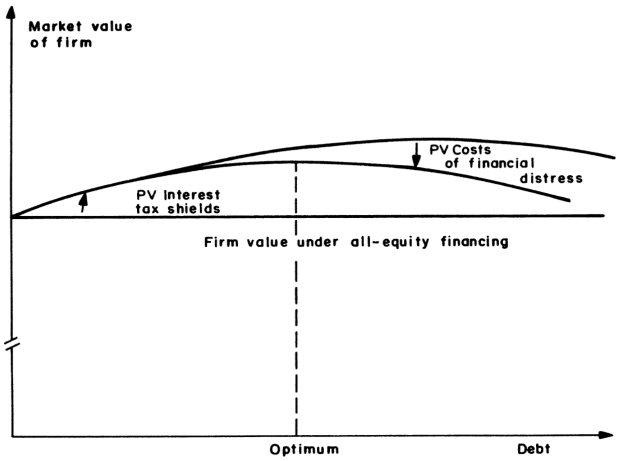

Diagram 2: Illustration of the static-tradeoff theory of capital structure (Myer, 1984).

2.7 Interest coverage ratio

Berk and DeMarzo (2016) define the interest coverage ratio as a measure of a company's capability to meet its interest obligations on borrowings. A high interest coverage ratio indicates that a company has substantial profits relative to its interest-bearing liabilities. Furthermore, a high interest coverage ratio signals that the loans have a low risk of default. The interest coverage ratio is highly correlated to the markets relative risk levels, as it incorporates both business risk and financial risk into one measure (Foss, 1995). During

financial hard times, the interest coverage ratio is important to an investor as it focuses on an issuer’s most important financial trend.

During the profitable years in the real estate sector, the interest coverage ratio was not a concern. However, economic development has put increased pressure on companies' interest coverage ratios, as a critical metric for assessing a company’s creditworthiness (The Financial Supervisory Authority, 2023).

2.8 Property acquisition

When a business is prospering, they often seek to sustain growth and profitability. For real estate companies, a strategic approach to achieve this may involve acquiring properties that present new business opportunities. The acquisition of properties comes with certain types of risk on one hand, but also a chance to a good deal, on the other hand. If the acquisition results in increased geographic diversification of the property portfolio, it reduces the overall risk exposure to local market fluctuations. Furthermore, broadening the real estate company´s mix of property types can also reduce the overall risk, as different types of property assets faces different risks during economic cycles (Handelsbanken, 2020). However, acquisitions raise a financial risk. If the acquisition is financed with debt, there is always a risk that the borrowing company fails to meet its obligations. During financial hard times the risk becomes more evident. Furthermore, property acquisitions are less frequent during recessions. In such times, it becomes especially important that the acquisitions that do take place represent a good deal.

2.9 Vacancy rate

Office properties make up a large part of the real estate sector. After the outbreak of the COVID-19 pandemic in March 2020, various restrictions were enforced to limit the spread of the virus, forcing both households and businesses to adapt, notably by shifting to remote work. Consequently, the vacancy rate for office properties increased. Following the pandemic, the changes in preference and attitude towards remote work has caused vacancy rates to increase to a permanently higher level than before its outbreak (The Swedish National Bank, 2022).

Increased vacancies reduce income for real estate companies since no rent is collected from empty properties. Over time, this scenario may precipitate a reduction in rental prices and property values for comparable office spaces due to an oversupply. The Swedish National Bank (2022) notes that higher vacancy rates heighten financial risks among real estate companies, potentially compromising their ability to meet obligations to creditors, such as banks and investors through corporate bonds.

2.10 Vix index

The VIX index, also known as the CBOE Volatility Index, is an index that measures market expectations of volatility on the US stock market over the next 30 days. It is a forward-looking index that provides insights into the market sentiment. A high VIX index suggests that the market anticipates significant turbulence in the coming 30 stock market days, while a low VIX index indicates expectations of a more stable market. Although the future of the stock market is inherently unpredictable and can fluctuate in either direction, the VIX index serves primarily to reflect these market expectations (Avanza, ND).

The VIX index is derived from option prices that are based on the S&P 500. When the market is uncertain, investors tend to buy these options as a hedge against sudden market fluctuation as they will yield returns if the stock market falls. Consequently, if many investors anticipate significant market volatility, there will be increased demand for these options. This surge in demand drives up the VIX index, earning it the nickname “fear index” (S&P Dow Jones Indices, ND). According to S&P (ND), the VIX index is interpreted as follows:

- **0-15:** Low, typically indicates optimism in the market
- **>15-20:** Moderate, typically indicates normal market environment
- **>20-25:** Medium, typically indicates growing concern in the market
- **>25-30:** High, typically indicates turbulence in the market
- **>30:** Extremely high, typically indicates extreme turbulence in the market

A high VIX index indicates that investors are scared and expect large price changes. This can be a sign of disturbing events such as political crises, economic downturns or other global impact factors.

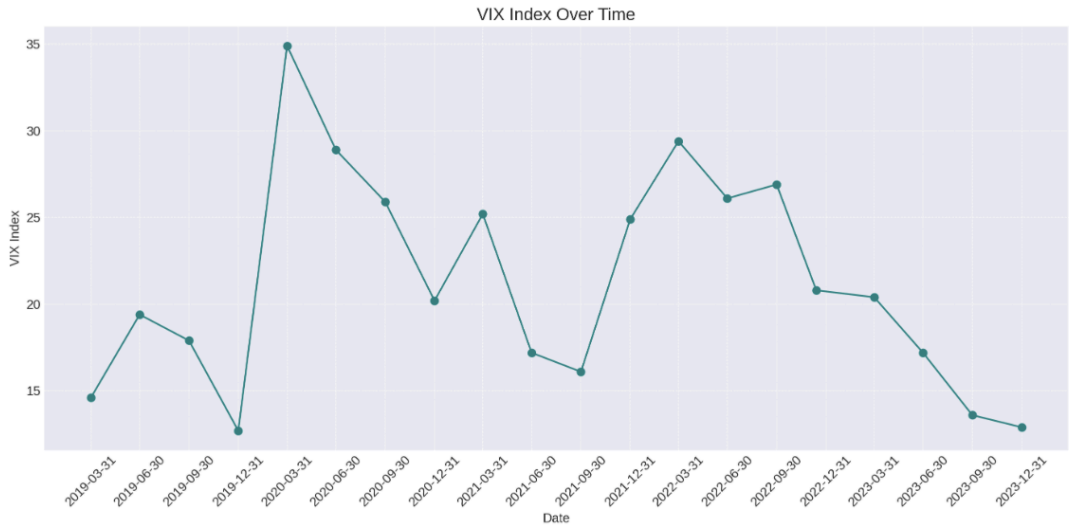

Diagram 3: Illustration of the VIX index during 2019-2023. Source: Yahoo Finance (ND)

3. Literature Review

Merton (1974) is one of the first research papers on the credit spread puzzle. By developing his own pricing method on corporate liabilities when there exists a significant probability of default, he concludes that a bond's yield is determined by the term structure and the probability of default. However, a given term structure is assumed, thus, this study states that the credit spread can be explained solely by the default risk, suggesting that the default risk is the same as the credit risk. Huang and Huang (2003) uses Mertons (1974) pricing method framework to investigate this relationship further. The key to their approach is to compare Merton's model with the available historical data on bond default. In contrast to Merton's (1974) result, their study shows that the default risk does not solely explain the credit spread, and that the explanatory power of the default risk varies among different types of bonds. They conclude that for investment grade bonds of all maturities, default risk accounts for only 20% of the credit spread. For investment grade bonds with a 10 year maturity, default risk explains 30% of the spread, while bonds of the same rating but shorter maturities, default risk accounts for a smaller fraction. In the case of high yield bonds, default risk represents a substantially greater proportion of the credit spread (Huang & Huang, 2003).

However, there exists no consensus regarding that Mertons´ (1974) pricing model is sufficient in explaining the entire credit spread, leading researchers to continue exploring alternative models to quantify default risk. Longstaff, Mithal and Neis (2005) utilize the credit default swap premia as a proxy for default risk. The credit default swap is a common

type of credit derivative that can be considered similar to an insurance contract compensating the buyer for losses arising from default. Their findings indicate that this method accounts for a greater proportion of the credit spread compared to the approach by Huang and Huang (2003). Specifically, it explains 51% of the credit spread for investment grade bonds and 83% for high yield bonds (Longstaff, Mithal & Neis, 2005).

Helwege, Huang and Wang (2014) analyze the impact of liquidity risk on credit spreads by examining corporate bonds that were issued and traded by the same company on the same day, thus eliminating other credit risk factors. By using several common proxies for liquidity as an explanatory variable for credit spreads and testing them in a cross-sectional regression, their result is that liquidity accounts for less than 10% of the variation in credit spreads. Their observed result is applicable for both investment grade bonds and high yield bonds. Wu, Yang & Su (2022) investigates the effect of credit risk factors, liquidity risk factors and the impact of their interaction on credit spreads. They perform a panel data regression, using data from 3716 bonds in China spanning from July 2006 to June 2016, with proxies for liquidity risk and credit risk factors which represent possible proxies for default risk. Their findings indicate that credit risk, liquidity risk and their interplay affects the bond spreads positively, thus neither factor fully accounts for the entire spread. The study further concludes that the effect of an increased liquidity risk and credit risk on corporate bond spreads is larger during financial crises compared to normal periods (Wu, Yang & Su, 2022). Foss (1995) conducts a study where he quantifies risk on the corporate bond market by examining yield spread volatility as a function of credit rating, liquidity risk and market risk. In line with Helwege, Huang and Wang (2014) and Wu, Yang & Su (2022), his findings indicate that a higher liquidity risk generates wider spreads. Furthermore, he notes that the variable interest coverage ratio is a key indicator of credit risk during unstable economic conditions, as it reflects both a business risk and a financial risk, where a high interest coverage ratio decreases credit risk (Foss, 1995).

Another study by Collin-Dufresne, Goldstein and Martin (2001) investigates the determinants of credit spread changes on industrial bonds by conducting and analyzing a panel data regression. Firm leverage, changes in firm volatility, measured with the VIX-index as a proxy, and changes in business climate are some of the variables included in the model. Their findings indicate that all three variables have a statistically significant relationship with the credit spread. Regarding leverage, their findings suggest that for high yield bonds, leverage

and credit spreads have a strong relationship, where a higher leverage increases credit spreads. However, the relationship is weaker for low-leveraged firms. Regarding volatility, they found that an increase in the VIX index dramatically increases credit spreads, whereas decreases in the VIX index do not have a dramatic impact. Lastly, the overall business climate, measured in the return on the S&P 500, has a negative impact, where a worsen economic state increases credit spreads. Another approach to leverage impact on credit spreads is presented in a study by Flannery, Nikolova and Öztekin (2012). They argue that in an efficient market, credit spreads should reflect not only the issuer's current risk but also investors' expectations about potential changes in that risk over time. Based on the trade off theory, among others, they determine future leverage estimates. The theory states that firms currently operating below their leverage target will prefer to issue debt, thus increasing leverage expectations Flannery, Nikolova and Öztekin (2012). Furthermore, they argue that firms with a plus or minus in their credit rating will be less likely to issue debt, thus decreasing leverage expectations By constructing a panel data regression with data for leverage and leverage expectations variables, along with several control variables divided into bond-specific variables, firm specific variables and several market variables, they conclude that investors' expectations about future leverage has a positive relationship with the credit spreads. Thus, leverage is a critical indicator for credit spreads, as spreads tend to increase with higher leverage and when investors anticipate an increase in leverage (Flannery, Nikolova & Öztekin, 2012).

King and Kang (2005) conducts a cross-sectional regression analysis to examine the importance of systematic equity factors in explaining yield spreads on corporate debt and analyze both bond-specific and firm-specific variables, such as leverage, maturity and rating. In accordance with Collin-Dufresne, Goldstein and Martin (2001) they find a significant, positive relationship between the spread and leverage where the relationship appears even stronger for lower-rated bonds. The bond-specific variables appear to explain a large portion of the variation where maturity and rating, on a statistically significant level, explains variations in credit spreads with a positive correlation. Truck, Laub and Rachev (2004) focuses their study towards the impact of maturity and rating where they, based on previous research, conduct and compare several models and their implications to state their result. They observe a positive relationship between spreads and maturity for investment grade rating classes, while the results for lower rated bonds are of limited explanatory power, the same result holds across all models.

A study by Demirovic, Tucker, and Guermat (2015) investigates whether accounting information or market information has more relevance in explaining the credit spread variation on corporate bonds in a set of panel data models based on data from US bonds. They find that market-based measures consistently outperform accounting-based measures, as market measures capture variation in other factors influencing the spread, such as overall market condition. Moreover, they conclude that accounting information, in combination with market-measures, is not enough to fully explain the spread. In addition to bond-specific and firm-specific variables, researchers have explored macroeconomic factors to understand the variations in credit spreads. Dewatcher, Lania, Lemke and Lyrio (2018) study economic and financial factors that fluctuate with the economic cycle, in their determination of euro area corporate bond spreads over the period 2001-2015, which is a time that includes sovereign debt crisis periods. Their findings indicate that during the studied period, macroeconomic factors such as inflation and business conditions are responsible for 25 percent of the variation in credit spreads for investment grade bonds. Financial factors, such as the cost of borrowing and market volatility explains about 50 percent of the variation (Dewatcher, Lania, Lemke & Lyrio, 2018).

Leland and Toft (1996) examines the firm's optimal capital structures and its effect on credit spreads during certain structural conditions. They create a model that evaluates firms as a function of their debt structure and applies it to different market settings, such as different risk-free interest rates. Their findings indicate that for companies that at certain times face a high risk, the relationship between interest rates and credit spread is positive. However, a study by Dupoyet, Jiang and Zhang (2023) reveals the opposite. Their study is focused towards the relationship between interest rates and credit spreads. By examining bond indices in a bivariate VAR system, accounting for endogeneity issues, they conclude that credit spreads are negatively affected by increases in interest rates. The observed impact is larger for high-yield bonds than for investment-grade bonds.

Previous studies have provided valuable insights into the factors influencing credit risk, thereby explaining variations in credit spreads. Yet, the complexity of credit risk persists across diverse settings, leaving the credit spread puzzle incomplete. While a consensus exists on effective model approaches for analyzing spreads, the explanatory power of the variables varies by region, period and sector. Notably, the bulk of existing research has centered on

major markets, predominantly the US bond market, and has often treated the bond market as an entity without considering sector-specific dynamics. These studies typically overlook how different sectors, each with their unique risk exposures, can influence credit spread variations.

There exists a gap in the literature that is pronounced in the context of the Swedish bond market, which has not been extensively explored, especially during periods of financial distress. Our study attempts to fill a part of this gap by focusing on Swedish corporate bonds from companies within the same sector, during an economically challenging period. This approach contributes to a more nuanced understanding of sector-specific risks that varies with the economy in credit spread analysis.

4. Method

This section will specify the studys´ methodological approach. First, the OLS regression model is defined followed by specifications of the collected data. Secondly the dependent variable is described together with all explanatory variables that are to be tested as well as their expected direction. Finally, the quality assessment is presented, providing the results of the specification tests.

4.1 Regression model

To address the problem statement, this study performs a pooled OLS regression model conducted in Stata following the structure:

$$y_i = \alpha + \beta_1 X_{i,1} + \ldots + \beta_k X_{i,k} + \varepsilon_i$$

where y_i is the dependent variable of observation i, α the intercept (a constant), β_k is the coefficient of explanatory variable k, $X_{i,k}$ the i'th observation for the explanatory variable k and ε_i is the error term for observation i.

Initially, the data is collected in an unbalanced panel data structure, involving quarterly data from 2019-2023. According to Brooks (2014), a time panel data can tackle a wider array of issues and address more complex problems. Brooks (2014) outlines the fixed effects model as an advantageous panel estimator approach. However, due to significant multicollinearity concerns, a panel data regression with fixed effects is not possible, therefore the choice of the pooled OLS. Further details and the implications of this choice are presented in section 4.5.

4.1.2 Hypotheses

When running the regression in Stata, the significance of each explanatory variable is tested. The null hypothesis for each variable is that the variable does not have a relationship with the credit spread. If we can reject the null hypothesis, it is statistically proved that there exists a relationship between the variable and the credit spread.

4.2 Data

4.2.1 Data collection

The study utilizes secondary data, which refers to pre-existing information. According to Bryman and Bell (2022), this kind of data is the most suitable for quantitative research, given that it is reliable.

Data is collected for every quarter of the time period 2019-01-01 to 2023-12-31, thus each bond will have data for 20 quarters. The study encompasses a survey of 40 corporate bonds in total, distributed among 12 companies (appendix 5). The bond-specific information time to maturity, yield to maturity, the swap rate, bid price and ask price is collected for each bond from Refinitiv Eikon. Refinitiv Eikon is a financial database designed for the analysis and monitoring of financial data.

The firm specific data net debt, current assets, total equity, acquisition of real estate properties and interest coverage ratio, are collected from S&P Capital IQ. Capital IQ is an advanced database that facilitates complex searches and provides detailed company information. Additionally, vacancy ratios are computed using the quarterly reports from each company for every quarter of each studied year. The credit ratings have been collected from the rating agencies Moody's, Standard & Poor's and Fitch. Data on the VIX index is obtained from Yahoo Finance, and the 3-month STIBOR rate is collected from the Swedish Financial Benchmark Facility.

4.2.2 Selection

To enable relevant comparison among the bonds, the study is limited to only include Plain Fixed Vanilla Coupon bonds. These bonds do not include additional features or options that might complicate their structure. It is crucial to confirm that observed variations in spreads in

the regression are not influenced by the bond´s structure. The bond has to be active and emitted no earlier than 2019-01-01, and no later than 2023-12-31.

The data is selected to include only bonds emitted by a Swedish real estate company. Additionally, non-listed companies are excluded from the study due to the absence of comprehensive financial data. Non-listed companies are not subject to the same accounting obligations as listed companies which complicated the process of locating this information in their quarterly reports.

Category	***Bond Criteria***
Bond-type	Plain Fixed Vanilla Coupon
Time Period	2019-01-01 - 2023-12-31
Category	***Firm Criteria***
Domicile	Sweden
Sector	Real estate
Additional criteria	Listed on Nasdaq Nordic

Table 2: Summary of selection criteria

4.2.3 Data loss

The criteria presented in section 4.2.2 yields a database consisting of 42 bonds and 14 firms. However, there is a data loss involving 2 bonds and 2 firms. The data loss appears due to the absence of firm-specific data for one of the bonds, and bond-specific information for the other bond. As a result, the final sample consists of 40 bonds and 12 firms. Moreover, as some of the bonds are emitted after the first observed quarter, the data suffer additional losses. 40 bonds observed over 20 quartels should yield a sample size of 800 observations, however the final sample size consists of 454 observations. However, the sample size is still sufficient to yield statistically significant insights.

4.3 Definition of variables

4.3.1 Dependent variable

The dependent variable of this study is the credit spread. The creditspread is the bond's yield to maturity subtracted by a risk-free rate with the same maturity. In this study the risk-free

rate is represented by the Swedish swap rate, which is used to reflect the fixed market rate (The Swedish National Bank, 2023). For each bond at each point of time, the yield has been matched to the corresponding swap rate with the same maturity. For instance, if a bond has a time to maturity of 5 years, the 5-year swap rate is subtracted from its yield. The credit spread is given in basis points.

$$Credit\ spread\ =\ Yield\ to\ Maturity\ -\ Swap\ rate \qquad \textit{(Equation 2)}$$

4.3.2 Independent variables

4.3.2.1 Bond specific variables

4.3.2.1.1 Time to Maturity

The time to maturity of a bond is a variable explaining the time left until its maturity date. Previous research (Truck, Laub & Rachev, 2001; King & Kang, 2005) shows that longer remaining maturities typically lead to wider credit spreads, due to the fact that longer maturity bonds appear to have higher market risk. Longer maturity bonds are more sensitive to market fluctuations, thus they can experience significant price changes, making them a riskier investment compared to shorter maturity bonds (King & Khang, 2005).

To determine the time to maturity, the remaining time until the bond's maturity day, measured in years, at each assessed observation point is collected. Based on previous research, this study anticipates a positive relationship between time to maturity and credit spread.

4.3.2.1.2 Liquidity

Liquidity is a variable stating the ability to sell a security quickly, at a price close to its value on a frictionless market, where a lower liquidity introduces a liquidity risk. Previous research (Helwege, Huang & Wang, 2014; Wu, Yang & Su, 2022) consistently demonstrates a negative relationship between liquidity and credit spread. Amihud and Mendelson (1986) define liquidity using the bid-ask spread, which is the difference between the prices at which a bond can be bought and sold. A higher bid-ask spread indicates a lower liquidity. In this study, the bid ask spread is calculated as follows, in accordance to Chen, Lesmond and Wei (2007):

$$Bid\ Ask\ Spread = \frac{Ask\ price - Bid\ price}{\frac{Ask\ price + Bid\ price}{2}} \qquad (Equation\ 3)$$

for every bond at every quarter. The bid ask spread is stated as a percentage. It is anticipated that a smaller bid-ask spread will result in a lower credit spread, while a wider bid-ask spread will lead to higher credit spreads. Therefore, the expected relationship between liquidity and credit spread is negative.

4.3.3 Firm-specific variables

4.3.3.1 Leverage

According to King & Khang (2005) leverage indicates a firm's level of debt, and a higher leverage ratio is associated with an increased probability of default, suggesting a positive relationship between leverage and credit spreads. This study will refer to leverage as the ratio between the net debt and total equity, stated in percentage, as this is a commonly accepted method in the real estate industry:

$$Leverage = \frac{Net\ debt}{Total\ Equity} \qquad (Equation\ 4)$$

King & Khang (2005) concludes in their study that the relationship between leverage and credit spreads are indeed positive and that it is an important determinant of the credit spread puzzle. Furthermore, Collin-Dufrense, Goldstein & Martin (2001) proves that a higher leverage corresponds to higher credit spreads. Based on former studies, the expected outcome in this study is a positive relationship between leverage and credit spread.

4.3.3.2 Interest coverage ratio

Berk and Demarzo (2016) define the interest coverage ratio as a metric assessing a company's ability to cover its interest payments on debt. This ratio is calculated using EBIT (Earnings Before Interest and Taxes) and interest expenses, reflecting the company's operational profitability and its financial commitments. Specifically, the formula used is

$$Interest\ Coverage\ Ratio = \frac{EBIT}{Interest\ Expenses} \qquad (Equation\ 5)$$

The metric is stated in percentage. Foss (1995) highlighted the significance of the interest coverage ratio as a comprehensive indicator that encapsulates both financial and business risks. He argued that credit analysts and bond investors, particularly in the corporate bond market, should monitor this ratio to anticipate market trends.

In the context of real estate companies, which are as mentioned typically highly leveraged, this ratio becomes even more critical. Such companies are especially vulnerable to rising interest rates, which can exacerbate credit risks and, consequently, widen credit spreads. During periods of high interest rates, a diminishing interest coverage ratio could signal increasing credit risk. Therefore, in this study, a lower interest coverage ratio is expected to correlate with higher credit spreads, underscoring a negative relationship between these two variables.

4.3.3.3.3 Property acquisitions

Property acquisition is a new explanatory variable that we have developed specifically to this sector as a measurement of investment activity. A common metric to measure investment expenditures is through the ratio CAPEX to total assets, which is calculated by dividing a firm's capital expenditure with their total assets. This metric is modified in order to measure acquisitions in properties. To create a metric that is comparable across companies, the total capital invested in acquisitions of every quarter are divided by the company's total assets of that quarter, providing a ratio stated in percentage.

$$Property\ acquisitions = \frac{Total\ capital\ invested\ in\ real\ estate}{Total\ assets} \qquad \textit{(Equation 6)}$$

This ratio gives an indication of how "aggressively" a company is investing in new assets relative to the size of its existing asset base. Since this variable has not previously been evaluated in this context, we do not have a clear perception of its impact on credit spreads based on previous literature. The impact is contingent upon the nature of the properties acquired, the financing methods employed, and the size of the acquisitions. In the regression model, the metric will examine the credit risk entailed by the size of the acquisition in relation to total assets. Companies with larger total assets and smaller acquisitions can generally be expected to be less risky. On the other hand, if a firm engages in substantial acquisitions relative to its total assets, it may be considered high-risk. There, the expected outcome is that a higher property acquisition ratio will increase credit spreads.

4.3.3.4 Vacancy

The vacancy rate is studied as a proxy of business risk associated with income losses created by holding vacant spaces. We have observed this variable as a potential indicator of credit risk in the real estate sector, thus aiming to investigate vacancy rate as an explanatory variable for credit spreads. The EPRA Vacancy Rate is used, which is a critical metric for real estate companies that shows the proportion of the total leasable area that for some reason remains unoccupied or unutilized. This rate is especially valuable to investors and property managers for evaluating the effectiveness of a property portfolio and its appeal in the market. To facilitate more accurate comparisons, areas undergoing development projects are excluded from the calculation. This exclusion helps prevent disproportionately high vacancy rates in firms focusing on property development. EPRA vacancy rate is the estimated market rent for vacant leases divided by the annual rental value of the entire property portfolio (European Public Real Estate Association, 2022).

$$Vacancy = \frac{Estimated\ market\ rent\ for\ vacant\ leases}{Annual\ rental\ value\ of\ the\ entire\ property\ portfolio} \qquad \textit{(Equation 7)}$$

The vacancy rate is stated in percentage. Since higher vacancy rates lead to lost rental income, it is a risk for real estate companies as well for investors holding the companies bonds. This variable has not been tested in this context before. Therefore, we can only make our own reasonable assumption about its impact. The expected result is that higher vacancy rates will yield higher credit spreads.

4.3.3.5 High Yield

As stated in section 2.4, sustaining an investment grade rating offers considerable advantages to a company, whereas holding a high yield rating introduces substantial challenges. Throughout the period from 2019-01-01 to 2023-12-31, all companies included in this analysis held an investment grade rating at some point. However, some companies experienced periodic downgrades to high yield status. High yield bonds carry a credit risk due to elevated financing costs for the issuing company. Investors holding bonds from a company with a high yield rating encounter increased risk of not recovering their investment, primarily due to default and liquidity risks. Therefore, a high yield grade may cause an increase in credit spreads for the specific bond. Previous studies agree that, all else being equal, high yield bonds tend to exhibit higher credit spreads than investment grade bonds

(Longstaff, Mithal and Neis, 2005; Helwege, Huang and Wang, 2014; Collin-Dufrense, Goldstein and Martin, 2001; Huang and Huang, 2003).

To capture the increase in risk associated with a high yield rating, a dummy variable for high yield bonds is included in the study. The expected outcome is that a high yield grade will increase the bond spreads, indicating a significant shift upwards in the OLS trendline, explained solely by the category high yield. An important note is that the bond's classification as high yield or investment grade is considered to be a firm-specific variable in this study, as all bonds issued by the same company will share the same rating, as detailed in section 2.4.

4.3.4 Market-specific variables

4.3.4.1 VIX-index

The relevance of the VIX index in understanding the volatility of the Swedish bond market stems from established research indicating significant interconnections among global financial markets (Liang, Wei & Zhang, 2020). Volatility in major stock markets, particularly the U.S. market, as the largest global economy, often precipitates volatility across other national markets. Nikkinen and Sahlström (2012) note that fluctuations in the U.S. market typically propagate uncertainty to other markets worldwide, affecting integrated markets where expectations of uncertainty in one are mirrored in others.

During periods of economic instability, understanding market risks becomes increasingly important. While equity markets monitor fluctuations through the VIX index, bond markets focus on credit spreads. However, these indicators are interlinked: volatility in the equity market is often used as a key input in modeling credit risk (Credit Benchmark, 2022). This connection highlights the involuted relationship between stock market behavior and bond market perceptions of risk.

Collin-Dufresne, Goldstein, & Martin (2001) studies the relationship between the VIX index and corporate bond spreads and finds that a higher VIX index leads to increased credit spreads. However, in their study, the VIX index is used as a proxy for firm volatility. We will interpret the VIX index as a proxy for market uncertainty. The expected outcome is that a higher VIX-index will increase the credit spreads.

4.3.4.2 3-month Stibor

The 3-month Stibor (Stockholm Interbank Offered rate) serves a benchmark rate commonly used in financial contracts involving SEK with variable interest rates. An increase in the Stibor rate suggests that the market anticipates that the National Bank will raise interest rates, typically in response to inflation or economic instability (Swedish National Bank, ND).

Dupoyet, Jiang and Zhang (2023) concludes that credit spreads do respond negatively to increased interest rates. They state that this relationship is robust to macroeconomic shocks, market uncertainty and business cycles. In their research, the interest rate is a part of the yield and therefore studied as a bond-specific variable. In contrast, Leland and Toft (1996) finds a positive relationship that occurs when interest rate affects a firm's financial health and thus, its value.

Since this study aims to investigate bonds with a fixed coupon rate, the interest rate will not directly affect the bond. In this context, the interest rate becomes a market measure of the business cycle. The 3 month Stibor provides a good measure of the overall economic state since it reflects the economic perceptions that both companies and investors act upon. The expected result is that the Stibor rate and credit spreads have a positive correlation. As illustrated below, the Stibor rate increases significantly after the first quarter of 2022. Drastic changes within interest rates come with uncertainty and unfavorable economic conditions for companies, thus affecting the credit risk. It is therefore relevant to study the relationship to the credit spread. As it is stated that interest rates increase credit risk, it is also relevant to expect a positive relationship to the credit spread.

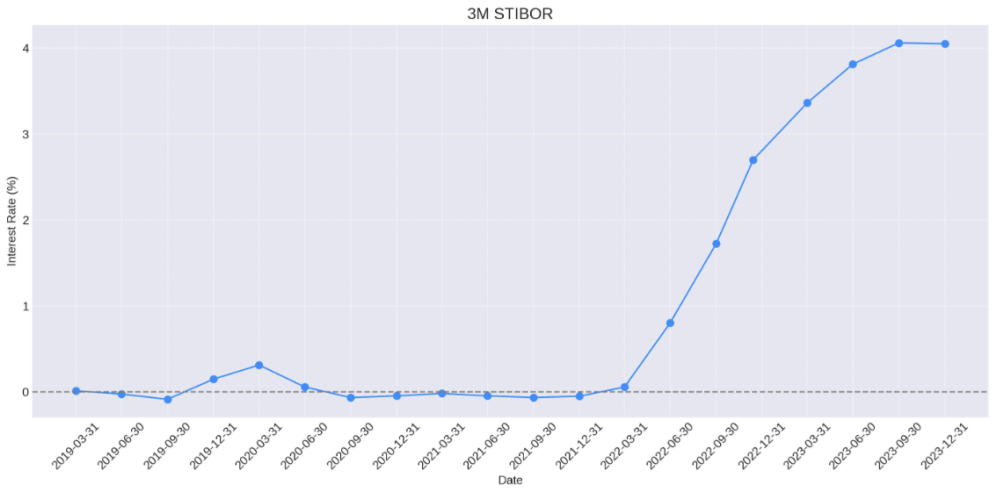

Diagram 4: Illustration of the 3 month Stibor rate from 2019 - 2023

4.3.5 Time dummies

This study focuses on a period marked by significant economic uncertainty and a fluctuating economic climate, which will be included in the model as an additional explanatory variable for the creditspread. As stated in section 4.1, we were not able to perform a panel data regression. To incorporate a time perspective in the pooled OLS model, we have created time dummies. Based on the market volatility and the developments in the Stibor rate during this timeframe, three distinct periods have been identified as critical for further analysis. In particular, two time-dummies have been created to incorporate these three periods.

The first period extends from the first quarter of 2019 to the last quarter of 2019. As illustrated in the VIX index (diagram 3) and the 3 month Stibor rate (diagram 4), this period features low interest rates, occasionally reaching below zero, and exhibits low volatility. Considering these conditions, this period is regarded as stable with a normal economic state. This period will be used as the baseline in the model against which the other two periods are compared.

The second period starts with the onset of the COVID-19 pandemic in the first quarter of 2020 and extends to the last quarter of 2021. Observations of the VIX index (diagram 3) and 3 month Stibor rate (diagram 4) during this time indicate an economic shift. The Stibor rate remains low, while the VIX index shows an exceptionally high rise, signaling high volatility and market uncertainty. Market uncertainty is frequently linked to higher risk, thus it is anticipated that credit spreads will increase during period 2.

The third period spans from the first quarter of 2022, starting with the onset of the Russian-Ukrainian war, to the last quarter of 2023. During the beginning of this time period, the VIX index presents high levels, however, still lower than in period 2. In contrast to period 1 and 2, the Stibor rate increased significantly, which is what characterizes period 3. It is anticipated that this period will see increased credit spreads due to the elevated risk associated with investing in corporate bonds when high interest rates and uncertainty on the market is present.

If a dummy variable is statistically significant, its coefficient indicates a shift in the OLS trend relative to the baseline category. This shift quantifies the difference in credit spread associated solely with the specific time period, holding all other variables constant.

4.4 Summary of expected direction of the coefficients

Bond-specific Variable	***Measure***	***Expected direction of the coefficient***
Time to maturity	Years left to maturity	+
Liquidity risk	Bid ask spread	+
Firm-specific Variable	***Measure***	***Expected direction of the coefficient***
Leverage	Net debt to total equity	+
Interest coverage ratio	EBIT to interest expenses	–
Acquisitions	Acquisition of real estate to total assets	+
Vacancy rate	The EPRA vacancy rate	+
Rating	Dummy variable for high yield	+
Market-specific Variable	***Measure***	***Expected direction the coefficient***
VIX - index	VIX-index	+
3-month Stibor	3- month Stibor	+
Time Variable	***Measure***	***Expected direction of the coefficient***
Period 2	Time dummy for 2020-03-31 to 2021-12-31	+
Period 3	Time dummy for 2022-03-31 to 2023-12-31	+

Table 3

4.5 Quality assessment

4.5.1 Specification test

Several specification tests are performed in order to ensure that the specified model is correct. Initially, the structure of the regression would follow a fixed effect model, thus without a dummy variable. Therefore, the multicollinearity test is conducted on the fixed effect model. Due to the outcome of the test, a pooled OLS model is used. Thus, the heteroscedasticity test and normality test is conducted on the pooled OLS model.

4.5.1.1 Multicollinearity

When employing the OLS estimation method, it is implicitly assumed that the explanatory variables are not correlated with each other. The presence of high correlation between two or more variables introduces a problem known as multicollinearity (Brooks, 2014). If multicollinearity would be present but overlooked, the model might display a high R^2, yet with insignificant individual variables. Moreover, the addition or removal of a variable could cause large changes in the coefficient values or the statistical significance of the variables (Brooks, 2014). In order to detect potential issues with multicollinearity, a Variance Inflation Factor (VIF) test is conducted in Stata. The VIF-test reveals the presence of multicollinearity in the fixed effects model (Appendix 1).

To identify which variables that contributes to multicollinearity, a correlation matrix is constructed, yet it reveals no significant correlations, confirming the appropriateness of retaining all variables in the regression (Appendix 2).

Brooks (2014) points out that multicollinearity typically indicates an issue with the data rather than with the model itself. In this study, the dataset is structured such that each bond has unique bond-specific data, while bonds from the same issuer share the same firm specific data. On top of that, the VIX index and 3 month Stibor rate are constant across all bonds. The VIX index and the 3 month Stibor rate creates an almost perfect multicollinearity with the fixed effect variables. As a result, a panel regression with fixed effects is impossible to run.

Brooks (2014) suggests mitigating the presence of multicollinearity by shifting from a fixed effects model to a pooled OLS model. In a pooled OLS, every single row is treated as a separate observation, simply ignoring that the data is a panel data. As long as the presence of homoscedastic standard errors are ensured, the OLS estimator will remain efficient. In the OLS model three dummy variables are included. To ensure that these variables do not suffer from multicollinearity, an additional correlation matrix is performed among these dummy variables. The result reveals no strong correlation (Appendix 5).

4.5.1.2 Heteroskedasticity

In order to ensure that the OLS estimators will give the best linear unbiased estimators, a test for heteroscedasticity is performed. Heteroscedasticity occurs when the variance of the errors are not constant (Brooks, 2014). The consequence of using OLS in the presence of

heteroscedasticity is that the standard errors would be wrong and hence any inferences made could be misleading. Brooks (2014) notes that various tests can be used to detect heteroscedasticity, and for this study, the Breush-Pagan test is applied using Stata. The outcome of the test yields a P-value below the significance level, confirming the presence of heteroscedastic errors in the model (Appendix 3).

To cope with heteroscedasticity, Brooks (2014) suggests different solutions, including the use of robust standard errors, which is the approach taken in this study. Implementing robust standard errors adjusts the computation such that if the variance of the errors is positively related to the square of an explanatory variable, the standard errors of the slope coefficients are increased compared to those obtained through the standard model. This adjustment leads to more conservative hypothesis testing, requiring stronger evidence to reject the null hypothesis (Brooks 2014).

4.5.1.3 Normality

Brooks (2014) highlights the importance of the normality assumption, which is required in order to conduct hypothesis tests about the model parameters. A Jarque-Bera test is performed in Stata to investigate the normality of the residuals in the model. The test suggests non-normality in the residuals (Appendix 4). Brooks (2014) states that normality occurs for different reasons, however for financial modeling, it is quite often the case that one or two very extreme residuals cause a rejection of the normality assumption. However, due to the rich sample size we can assume that the residuals are approximately normally distributed.

5. Results

This section will present the results in broad terms and provide a summary of the regression model´s findings. First, a table of descriptive statistics is presented providing an overview of the data. Second, the regression models are presented. In the following analysis part, all variables, their significance and coefficients are specified as well as a discussion of their outcome.

5.1 Descriptive statistics

Variable	Obs	Mean	Std.Dev	Min	Max
Credit spread	454	197,337	109,837	23,13	718,626
Maturity	454	3,172	1,429	0,11	8,554
Bid Ask Spread	454	0,004	0,004	0	0,03
Leverage	454	1,096	1,137	0,218	9,54
Interest Coverage Ratio	454	5,731	4,753	0,3	46
Acquisitions	454	0,013	0,0316	0,002	0,462
Vacancy	454	0,063	0,021	0,008	0,11
VIX	454	21,26	6,081	12,7	34,9
3M Stibor	454	0,010	0,015	-0,0008	0,040

Table 4: Descriptive statistics. Note: The Dummy variables are excluded from this table as they can only take values of 0 or 1

5.2 Regression Result

5.2.1 Regression 1

$$Credit\ Spread_i = \alpha + \beta_1 Maturity_i + \beta_2 Bid\ Ask\ spread_i + \beta_3 Leverage_i + \beta_4 Interest\ coverage\ ratio_i + \beta_5 Acquisition_i + \beta_6 Vacancy_i + \beta_7 Vix\ index_i + \beta_8 3M\ Stibor\ rate_i + \gamma_1 High\ Yield + \gamma_2 Period\ 2 + \gamma_3 Period\ 3 + \varepsilon_i$$

Credit Spread (BP)	*Coefficient*	*P>|t|*
Maturity	14,12	0,000
Bid Ask Spread	0,33	0,030
Leverage	0,23	0,000
Interest Coverage Ratio	- 0,59	0,237

Acquisitions	3,23	0,000
Vacancy	4,96	0,000
VIX	0,06	0,000
3M Stibor	30,50	0,000
High yield	97,05	0,000
Period 2	- 35,20	0,002
Period 3	43,72	0,012
_cons	-129,3051	0,000

Number of observations	454
F (11, 442)	110,54
R-squared	0,5829
Adjusted R-square	0,5725

Model 1

Regression 1 suggests a statistically significant result for the overall model, which can be understood by the P-value of 0,00 from the F-test, indicating that at least one of the variables must be significant. However, the variable *interest coverage ratio* turns out to be non-significant. Therefore, a second regression is conducted following the exact same structure, except for the exclusion of the *interest coverage ratio* variable. Including an irrelevant variable in a model can have specific consequences: it maintains the consistency and unbiased nature of the coefficient estimators but makes them less efficient. Furthermore, the inclusion of an irrelevant variable often leads to inflated standard errors for the coefficients compared to their values without the irrelevant variable. Additionally, variables that might have been considered marginally significant could lose their significance due to the burden of an irrelevant variable. Generally, the extent of efficiency loss is directly proportional to the level of correlation between the irrelevant variable and other explanatory variables in the model (Brooks, 2014).

5.2.2 Regression 2

Credit Spread (BP)	*Coefficient*	*P>|t|*
Maturity	13,87	0,001
Bid Ask Spread	0,34	0,028
Leverage	0,24	0,000
Acquisitions	3,31	0,000
Vacancy	5,11	0,000
VIX	7,03	0,000
3M Stibor	31,24	0,000
High yield	97,56	0,000
Period 2	-36,35	0,001
Period 3	42,38	0,014
_cons	-136,06	0,000

Number of observations	454
F (10, 443)	119,24
R-squared	0,5825
Adjusted R-square	0,5730

Model 2

Regression 2 suggests a statistically significant result for the overall model, which can be understood by the P-value of 0,00 from the F-test, indicating that at least one of the variables must be significant.

To understand how well the model explains the creditspread the adjusted R-square is observed. The adjusted R-square, in contrast to the normal R-square, compensates for the inclusion of adding more variables to the model which makes it the best metric for understanding the model´s ability to explain the dependent variable (Brooks, 2014). The adjusted R-square of this model is 57,30%, indicating that 57,30% of the variance in the credit spread can be explained by the variables presented in this regression.

6. Analysis and Discussion

In this following section, the result from model 2 is further explained. The variables are analyzed from previous studies and our expectations, in order to highlight any differences or similarities. Furthermore, possible explanations to, and a discussion around, our results are presented.

6.1 Significant Variables

Bond - specific Variable	***Expected relationship***	***Observed relationship***	***Coefficient***
*Maturity****	+	+	13,87
*Liquidity***	+	+	*0,34*
Firm - specific Variable	***Expected relationship***	***Observed relationship***	
*Leverage****	+	+	*0,24*
*Acquisitions****	+	+	*3,31*
*Vacancy****	+	+	*5,11*
*High yield****	+	+	*97,56*
Market - specific Variable	***Expected relationship***	***Observed relationship***	
*VIX****	+	+	*7,03*
*3M STIBOR****	+	+	*31,24*
Time Variable	***Expected relationship***	***Observed relationship***	
*Period 2****	+	-	*-36,35*
*Period 3***	+	+	*42,38*

Table 5: Independent variables expected and observed relationship with the credit spread.
**** 1% significance level ; ** 5% significance level.*

6.1.2 Bond-specific variables

6.1.2.1 Time to Maturity

The variable time to maturity exhibits a positive relationship with the credit spread, thus a longer time to maturity increases the credit spread for a bond. The coefficient of 13.87 indicates that an increase (or decrease) of one year in time maturity raises (or lowers) the credit spread by 13.87 basis points. The result is in line with our expectations based on previous studies, that constantly observes a positive relationship between time to maturity

and credit spread (Truck, Laub & Rachev, 2001; King & Kang, 2005). The well-established theoretical framework for the time left to maturity is applicable to the setting of our study.

6.1.2.2 Liquidity

The bid-ask spread is positive with a coefficient of 0,33, indicating that a 1 percentage point increase (or decrease) in bid-ask spread increases (or decreases) the creditspread with 0,33 basis points. As a higher bid-ask spread indicates lower liquidity, the result aligns with previous research that liquidity has a negative relationship with credit spread (Helwege, Huang & Wang, 2014; Wu, Yang and Su, 2022).

However, the coefficient is relatively small, indicating that bid ask spread is not one of the variables that has the largest impact on the credit spread. As the bid ask spread is measured as the difference in bid and ask price in percentage, an increase by 1 percentage point in the spread can be considered relatively high, as it causes a significant liquidity risk for investors. Thus, the result implies that liquidity risk does not affect the spreads drastically.

6.1.3 Firm-specific variables

6.1.3.1 Leverage

The variable leverage demonstrates a positive correlation with the credit spread with a coefficient of 0,24. This demonstrates that a 1 percentage point increase (or decrease) in leverage corresponds to a 0,24 basis point rise (or decline) in the credit spread. As expected from prior research, leverage displays a positive relationship to the spread (Collin-Dufresne, Goldstein & Martin, 2001; Flannery, Nikolova & Öztekin, 2012; King & Khang, 2005). Thus, it can be concluded that the previous framework is applicable to the setting of our study.

The coefficient of 0,24 is relatively small. However, the result is reasonable given the nature of the leverage variable. A company's net debt to equity ratio varies across different periods, where a 1 percentage point increase in leverage does not indicate a much higher credit risk for the company. The credit risk becomes evident as leverage ratios increase dramatically.

The real estate sector is typically highly leveraged. Under stable economic conditions, substantial leverage may not present significant challenges for a real estate company. However, the dynamic shifts when interest rates rise, consequently increasing the cost of

debt. For companies with a high leverage ratio, this surge in debt costs can significantly strain financial resources, potentially leading to a failure to meet debt obligations, including payments to traditional banks and market financiers. This finding aligns with the Trade-Off Theory, which posits that companies with high leverage are more vulnerable to interest rate increases. As interest rates climb, the optimal capital structure may shift, where the heightened credit risk that comes with high leverage widens the credit spreads.

6.1.3.2 Property Acquisitions

The impact of property acquisitions, represented by a coefficient of 3,31, reveals that as the acquisition investments increase (or decrease) by 1 percentage point, the credit spread increases (or decreases) with 3,31 basis points. The result aligns with the expected outcome.

It can be considered reasonable that an increase or decrease in property acquisition with one percentage point should not generate a drastic change in credit risk. However, the result implies that even small changes in property acquisition entails a relatively high credit risk. This highlights the importance for investors to observe this metric since high ratios can change the credit risk dramatically, thereby the credit spreads.

The result confirms that acquiring properties during the studied time period has been associated with significant risk. Therefore, it is understandable that investors demanded higher returns from real estate companies that have engaged in substantial property investment, further widening the credit spreads for corporate bonds emitted by real estate companies.

6.1.3.3 Vacancy

The variable vacancy presents a positive coefficient of 5,10, indicating that a 1 percentage point rise in vacancies leads to a substantial increase in credit spreads by 5,10 basis points. The coefficient is relatively high in comparison to the other firm-specific variables. This can be explained by the fact that an increase of 1 percentage point in the context of vacancy is considered relatively high since vacancy rates typically do not fluctuate much within the same firm. The positive relationship aligns with the expectations presented in the method section.

The most significant risk with vacant spaces is the loss of rental income. Without tenants, properties generate no revenue, yet still incur ongoing costs. Furthermore, when rental income diminishes or expectations of future rental income decline, property values fall which threatens the financial health of the company. Consequently the risk profile of a real estate company with high vacancy should be considered higher than the risk profile of a real estate company with lower vacancy rates. Consequently, bonds emitted by a firm with a high vacancy rate should serve a higher credit spread.

6.1.3.4 High yield

The dummy variable for high yield has a coefficient of 97,56. Since the high yield variable has been included as a dummy variable, the interpretation would be that, given that all other variables are equal, the credit spread will be 97,56 basis points higher for a bond with an high yield rating than for a bond with an investment grade rating.

The result aligns with our expectations as well as previous literature that has stated that bonds with a high yield grade carries a higher credit risk (Longstaff, Mithal and Neis, 2005; Helwege, Huang and Wang, 2014; Collin-Dufrense, Goldstein and Martin, 2001; Huang and Huang, 2003). The difference between high yield and investment grade has been shown to play a critical role when investors want to identify credit risk, a conclusion further supported by the notably high coefficient found in this result.

When the dummy variable takes on the value of 1, indicating that the bond is high yield, we see an upward shift in the OLS trendline. The shift is solely explained by the high yield rating. As mentioned in section 2.2, a high yield bond signifies risk and insecurity within the issuing company. When a company is downgraded, this is based on the fact that the company fails to demonstrate sufficiently good financial results. Therefore, a high yield rating of companies issued bonds implies that the company struggles financially, thus creating credit risk. Additionally, a company's credit rating is public, thus warning investors that their bonds suffer a higher credit risk. Consequently, a high yield rating drives up the credit spreads both due to the company’s actual risk and the investors perception of risk.

6.1.4 Market-specific variables

6.1.4.1 VIX index

The VIX index presents a positive correlation with a coefficient of 7,03, indicating that if the VIX index increases (or decreases) by 1 unit, the credit spread will increase (or decrease) with 7,03 basis points. By understanding the nature of the VIX index, it can be determined that it has a significant impact on credit spreads. As described in Section 2.11, the VIX index can range from 0 to 30. A low VIX index, with values between 0 and 15, signifies market optimism. However, the situation can change dramatically, where a high uncertainty and volatility in the market result in a VIX value over 25. The COVID 19 outbreak in the first quarter of 2020 illustrates such a drastic change, with the VIX index rising from 12,7 to 34,9 from one quarter to the next (see diagram 3). Thus, while a single unit increase in the index has a relatively small impact on credit spreads, overall, the VIX index has a substantial influence.

The result that market volatility increases credit spreads align with previous research (Collin-Dufresne, Goldstein & Martin, 2001; Dewatcher, Lania, Lemke and Lyrio, 2018). These results demonstrate that the bond market is sensitive to market uncertainties, which are captured by increased credit spreads during such turbulent times.

6.1.4.2 3-month Stibor

The 3-month Stibor interest rate has a coefficient of 31,24. This indicates that if the Stibor rate rises (or falls) with one percentage point, the spread will increase (or decrease) with 31,24 basis points. This increase is relatively large. However, it is important to note that an increase in the Stibor rate with one percentage point is substantial. Such an increase does not occur from one quarter to another. Instead, the increase (or decrease) occurs gradually over an extended period of time, as illustrated in diagram 4.

It is reasonable that the interest rate significantly impacts the credit spread, as the real estate sector is sensitive towards rising interest rates. The increasing interest rates have significantly affected the financial health of real estate firms. Consequently, the risk of investing in bonds emitted by a real estate company has increased, resulting in wider spreads.

This finding is in line with Leland and Toft (1996), who investigates the risk-free interest rate directly. Furthermore, Dewatcher, Lania, Lemke and Lyrio (2018) finds that the cost of

borrowing has a positive relationship with the spread, which aligns with our result as an increased interest rate indicates an increase in the cost of borrowing.

6.1.5 Time dummies

6.1.5.1 Period 2&3

The dummy variable for period 2 shows a negative coefficient of 36,35 suggesting that credit spreads decrease with 36,35 in period 2, all else being equal, compared to the baseline (period 1). This dummy variable captures all other possible explanations to the variation in creditspread that is not yet captured by the model. The result goes against the expectations presented in the method section, suggesting that we would observe a positive intercept.
The outcome of the coefficient of the dummy variable for time period 2 can still be considered reasonable. The real estate sector is often seen as stable and historically resilient to economic fluctuations (Avanza, 2020), something that was proved once again during the COVID-19 pandemic. The interest rates remained low during the pandemic which created favorable conditions for real estate sector since they were able to borrow money under advantageous conditions. Furthermore, property prices remained stable during this period and companies could present strong cash flows. A possible outcome of this is that investment within the real estate sector was considered to entail low risks. Investors seeking secure investments may have turned to real estate companies and, given the low risk, did not require as high returns on the corporate bonds issued by real estate companies during this period. Thus, credit spreads decreased.

Time period 3 shows a positive coefficient of 42.39, indicating an increase in spreads by 42.39 basis points compared to the baseline. Thus, suggesting that credit spreads increases with 42,39 basis points in period 3, all else being equal. The upward shift in the intercept aligns with the expectations.

This result is reasonable as it corresponds well with the significant challenges faced by real estate companies during this period. First, the real estate market has seen a decrease in transaction volumes, causing uncertainty around property valuations. This drop in transaction activity could further press down valuations, making it challenging to sell assets to manage debt maturities (S&P, 2022). Furthermore, the cost of construction and maintenance have increased rapidly since the Russian invasion of Ukraine, leading to high ownership costs and

difficulties in completing construction projects. On top of that, the profitability of these companies may have decreased, adding further risk. The general perception of this period has made investors more uncertain, and the risk profile associated with real estate companies has increased, leading to a heightened demand for returns. These possible explanations support our findings.

7. Conclusion

The aim of this thesis is to analyze the factors contributing to the credit spread of corporate bonds emitted by Swedish real estate companies during a time of uncertainty and change, thereby providing valuable insights into the credit spread puzzle within this setting. More specifically, we seek to answer the research questions: *Are explanatory variables, identified in previous studies of credit spreads, applicable to the Swedish real estate sector during the studied period?* and *Are there additional, sector-specific, explanatory variables that can further explain the credit spread of bonds emitted by Swedish real estate companies?* The analysis is conducted using a pooled OLS regression model with nine potential explanatory variables, all of which, except for time to maturity, fluctuate with economic cycles. Additionally, two time dummy variables are incorporated in the model to explain differences in the credit spreads during different economic states. The findings indicate that the explanatory variables identified in previous studies of credit spreads are indeed applicable to the real estate sector during the studied period. Specifically, time to maturity, liquidity, leverage, the VIX index, the 3-month Stibor rate and the high yield category have a statistically significant impact on credit spreads. Furthermore, this study identifies new sector-specific explanatory variables: property acquisition and vacancy rate, that to the best of our knowledge, have not been tested in this context before. By revealing these variables, we provide investors with new metrics to evaluate when analyzing the credit risks associated with corporate bonds issued by Swedish real estate companies.

The goal of this study was to contribute to the existing literature of the credit spread puzzle from a new point of view. However, we do not claim that the results are generalizable. Nevertheless, within the constraints of the available time and limited data, we have, to the best of our ability, conducted the study as efficiently as possible.

7.1 Future studies

Our study opens up for future research. To further develop the sector-specific impact on credit spreads, it would be interesting to include multiple sectors in the same study. This approach would allow an examination of how the explanatory variables vary between sectors and to investigate the underlying reasons for these variations. Furthermore, in our study, we have been able to make reasonable assumptions about the volatility of the variables and their potential impact on credit spreads. To advance these assumptions, it would be beneficial for future research to quantify the volatility, thus providing a deeper understanding of the effects of the explanatory variables. Finally, some of the measures used in the study serve as proxies to capture a specific credit risk. For instance, the VIX index, an American measure of volatility, is included in the study based on the assumption that larger markets influence smaller ones. It would be interesting to examine more precise measures of market volatility, tailored to the specific market.

8. Reference list

Alfelt, G., Olsén, N., Och, I. and Regnér, M. (2022). *Finansiella stabilitetsrisker till följd av minskad efterfrågan på kontor*. [online] Available at: https://www.riksbank.se/globalassets/media/rapporter/ekonomiska-kommentarer/svenska/2022/finansiella-stabilitetsrisker-till-foljd-av-minskad-efterfragan-pa-kontor.pdf.

Amihud, Y. and Mendelson, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics*, [online] 17(2), pp.223–249. doi:https://doi.org/10.1016/0304-405x(86)90065-6.

Andersson, A. (2022). Stormig obligationsmarknad för fastighetssektorn, https://www.swedbank-aktiellt.se/2022/augusti/stormig_obligationsmarknad_for_fastighetssektorn.csp. [Accessed 25 April 2024]

Avanza (n.d.). *Vad är nyckeltalet volatilitet? | Avanza*. [online] www.avanza.se. Available at: https://www.avanza.se/lar-dig-mer/avanza-akademin/aktier/vad-ar-volatilitet.html.

Bell, E., Bryman, A. and Harley, B. (2022). *Business Research Methods*. 5th ed. Oxford: Oxford University Press.

Berg, J., Braconier, H., Goldkuhl, E., Hörngren, L., Karlsson, M., Kvist, A., Nielsen, T., Otz, A. and Palmqvist, S. (2023). *Fastighetsföretagen kan behöva minska sin skuldsättning*. [online] Available at: https://www.fi.se/contentassets/ad79bee9d7a74ae189e8aa025b47eabd/fi-analys-41-fastighetsftg-minska-skuld.pdf.

Berk, J.B., Demarzo, P.M. and Jarrad V T Harford (2016). *Fundamentals of corporate finance*. Boston: Pearson Education.

Brigham, E.F. and Gapenski, L.C. (1991). *Financial management*. Thomson Higher Education.

Brooks, C. (2014). *Introductory econometrics for finance by Chris Brooks, 3rd edition*. Bellevue, Washington: Content Technologies.

CHEN, L., LESMOND, D.A. and WEI, J. (2007). Corporate Yield Spreads and Bond Liquidity. *The Journal of Finance*, [online] 62(1), pp.119–149. doi:https://doi.org/10.1111/j.1540-6261.2007.01203.x.

Collin-Dufresne, P., Goldstein, R.S. and Martin, J.S. (2001). The Determinants of Credit Spread Changes. *The Journal of Finance*, [online] 56(6), pp.2177–2207. Available at: http://www.jstor.org/stable/2697820.

Credit Benchmark. (2022). VIX, Credit Spreads and Consensus Credit Risk [pdf], https://www.creditbenchmark.com/wp-content/uploads/2022/02/Insights-VIX-Credit-Spreads-and-Consensus-Credit-Risk-24.02.22.pdf.

Demirovic, A., Tucker, J. and Guermat, C. (2015). Accounting data and the credit spread: An empirical investigation. *Research in International Business and Finance*, 34, pp.233–250. doi:https://doi.org/10.1016/j.ribaf.2015.02.013.

Dewachter, H., Iania, L., Lemke, W. and Lyrio, M. (2018). A Macro-Financial Analysis of the Corporate Bond Market. *SSRN Electronic Journal*. doi:https://doi.org/10.2139/ssrn.3195252.

Dupoyet, B., Jiang, X. and Zhang, Q. (2023). A new take on the relationship between interest rates and credit spreads. *Applied Economics*, [online] pp.1–17. doi:https://doi.org/10.1080/00036846.2023.2168614.

European Public Real Estate Association (2022). *Best Practices Recommendations*. [online] Available at: https://www.epra.com/application/files/4116/7387/3193/EPRA_BPR_Guidelines.pdf [Accessed 5 May 2024].

Fabozzi, F.J. (2021). *Handbook Of Fixed Income Securities*. S.L.: Mcgraw-Hill Education.

Flannery, M.J., Nikolova, S. (Stas) and Oztekin, O. (2007). Leverage Expectations and Bond Credit Spreads. *SSRN Electronic Journal*, 47(4). doi:https://doi.org/10.2139/ssrn.1308172.

Foss, G.W. (1995). Quantifying Risk in the Corporate Bond Markets. *Financial Analysts Journal*, 51(2), pp.29–34. doi:https://doi.org/10.2469/faj.v51.n2.1878.

Handelsbanken. (2020). Fastighetsrapporten - insikter & utsikter [pdf], https://reonapi.researchonline.se/document/att/nGIAJUGV_kWsyOIYbgARZw2

Helwege, J., Huang, J.-Z. and Wang, Y. (2014). Liquidity effects in corporate bond spreads. *Journal of Banking & Finance*, 45, pp.105–116. doi:https://doi.org/10.1016/j.jbankfin.2013.08.018..

Huang, J.-Z. and Huang, M. (2003). How Much of Corporate-Treasury Yield Spread Is Due to Credit Risk?: A New Calibration Approach. *SSRN Electronic Journal*, 2. doi:https://doi.org/10.2139/ssrn.307360.

King, T.-H.D. and Khang, K. (2005). On the importance of systematic risk factors in explaining the cross-section of corporate bond yield spreads. *Journal of Banking & Finance*, 29(12), pp.3141–3158. doi:https://doi.org/10.1016/j.jbankfin.2005.01.007.

Kisgen, D.J. (2006). Credit Ratings and Capital Structure. *The Journal of Finance*, [online] 61(3), pp.1035–1072. Available at: https://www.jstor.org/stable/3699317.

Leland, H.E. and Toft, K.B. (1996). Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads. *The Journal of Finance*, 51(3), p.987. doi:https://doi.org/10.2307/2329229.

Liang, C., Wei, Y. and Zhang, Y. (2020). Is implied volatility more informative for forecasting realized volatility: An international perspective. *Journal of Forecasting*. doi:https://doi.org/10.1002/for.2686.

Longstaff, F.A., Mithal, S. and Neis, E. (2005). Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market. *The Journal of Finance*, [online] 60(5), pp.2213–2253. Available at: http://www.jstor.org/stable/3694747 [Accessed 20 April 2024].

Merton, R.C. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *The Journal of Finance*, 29(2), p.449. doi:https://doi.org/10.2307/2978814.

Myers, S.C. and Majluf, N.S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2), pp.187–221. doi:https://doi.org/10.1016/0304-405X(84)90023-0.

Nikkinen, J. (2012). International Transmission of Uncertainty Implicit in Stock Index Option Prices. *SSRN Electronic Journal*. doi:https://doi.org/10.2139/ssrn.302321.

S&P Dow Jones Indices (n.d.). *VIX | S&P Dow Jones Indices*. [online] www.spglobal.com. Available at: https://www.spglobal.com/spdji/en/vix-intro/.

S&P Global Ratings. (2022). Guide to Credit Rating Essentials [pdf], https://www.spglobal.com/ratings/_division-assets/pdfs/guide_to_credit_rating_essentials_digital.pdf

The Swedish National Bank. (2013). Utvecklingen på den svenska marknaden för företagsobligationer [pdf], https://archive.riksbank.se/Documents/Rapporter/Ekonomiska_kommentarer/2014/rap_ek_kom_nr07_141015_sve.pdf

The Swedish National Bank. (2023). Penningpolitisk rapport [pdf], https://www.riksbank.se/globalassets/media/rapporter/ppr/penningpolitiska-rapporter-och-uppdateringar/svenska/2023/penningpolitisk-rapport-februari-2023.pdf

The Swedish Financial Supervisory (2019). *Den kommersiella fastighets- marknaden och finansiell stabilitet*. [online] Available at: https://www.fi.se/contentassets/f0b2175448734d998679a33d8eaf8f6e/komm_fastighet_finstab.pdf.

The Swedish National Bank (2020). *Lån från MFI Värdepappersupplåning*. [online] Available at: https://www.riksbank.se/globalassets/media/rapporter/ppr/fordjupningar/svenska/2020/den-svenska-marknaden-for-foretagsobligationer-fordjupning-i-penningpolitisk-rapport-juli-2020.pdf [Accessed 2 May 2024].

The Swedish National Bank (n.d.). *Stibor*. [online] www.riksbank.se. Available at: https://www.riksbank.se/sv/statistik/rantor-och-valutakurser/forklaringar---rantor-och-valutakurser/svenska-marknadsrantor/stibor/#:~:text=Stibor%20(Stockholm%20 Interbank%20 Offered%20 Rate [Accessed 2 May 2024].

Trück, S., Laub, M. and Rachev, S. (2004). *The Term Structure of Credit Spreads and Credit Default Swaps - An Empirical Investigation*. [online] Ssrn.com. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=675641 [Accessed 10 April 2024].

Wu, Z., Yang, B., Su, Y. and Shaikhet, L. (2022). Liquidity, Credit Risk, and Their Interaction on the Spreads in Chinaâ€™s Corporate Bond Market. *Discrete Dynamics in Nature and Society*, [online] 2022, pp.1–19. Available at: https://econpapers.repec.org/article/hinjnddns/2996704.htm [Accessed 15 April 2024].

9. Appendix

Appendix 1: VIF test

Variable	VIF	1/VIF
VIX	9.91	0.100892
Maturity	9.37	0.106699
Vacancy	9.16	0.109229
bidaskspread	3.18	0.314602
Interestco~o	2.79	0.358457
Leverage	2.16	0.462298
MSTIBOR	2.08	0.481289
Acqusitions	1.14	0.878332
Mean VIF	4.97	

Appendix 2: Correlation matrix

	Swapsp~d	Maturity	bidask~d	Leverage	Intere~o	Acqusi~s	Vacancy
Swapspread	1.0000						
Maturity	-0.0870	1.0000					
bidaskspread	0.2511	0.4107	1.0000				
Leverage	0.2513	-0.0408	0.0630	1.0000			
Interestco~o	-0.3431	0.2567	-0.0567	-0.1655	1.0000		
Acqusitions	0.0033	-0.0215	-0.0330	0.0762	-0.0860	1.0000	
Vacancy	0.0343	0.1263	0.0119	-0.0757	-0.0931	-0.0502	1.0000
VIX	0.0939	0.2522	0.0979	-0.0564	-0.0095	-0.0716	0.0631
MSTIBOR	0.4639	-0.5238	-0.0324	-0.0408	-0.2919	-0.1061	-0.0063

	VIX	MSTIBOR
VIX	1.0000	
MSTIBOR	-0.3498	1.0000

Appendix 3: Heteroscedasticity test

```
. estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of Swapspread

H0: Constant variance

    chi2(1) = 124.47
Prob > chi2 = 0.0000
```

Appendix 4: Test for normality

```
. do "/var/folders/np/qmrz0hh5313b8typvw710_mh0000gn/T//SD75059.000000"

. jb6 residuals
Jarque-Bera normality test:    387 Chi(2)  9.2e-85
Jarque-Bera test for Ho: normality: (residuals)
```

Appendix 5: Correlation test for dummy variables

```
. pwcorr Highyield period2 period3

             | Highyi~d  period2  period3
-------------+---------------------------
   Highyield |   1.0000
     period2 |  -0.0788   1.0000
     period3 |  -0.0525  -0.6667   1.0000
```

Appendix 5: Company list:

1. Akelius Residential Property AB
2. Atrium Ljungberg AB
3. Castellum AB
4. Catena AB
5. Diös Fastigheter AB
6. Fabege AB
7. Fastighets AB Balder
8. FastPartner AB
9. Heimstaden Bostad AB
10. Hufvudstaden AB
11. Kungsleden AB
12. Samhällsbyggnadsbolaget I Norden AB