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Climbing the ladder of interest:
A study of the impact of interest rate hikes on corporate bond credit spreads in the U.S

Master Thesis

by

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ABSTRACT

This thesis examines the impact of interest rate hikes and other key economic variables on the credit spreads of corporate bonds. Based on rising interest rates and shifts in investor preferences, our study seeks to capture and understand the dynamics influencing corporate bonds. Utilizing fixed effects models and data from 2002 to 2022, we test the hypothesis that rate hikes significantly increase credit spreads due to heightened risk perception among investors. Our findings show that interest rate hikes impact investment-grade bonds in the short term, while high-yield bonds show no significant, isolated impact for both short- and long-term. These results underscore the importance of considering interest rate changes and heightened risk perception in investment and policy decisions.

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1 Introduction

In recent years, particularly from 2022 to today, we have seen a significant shift in the global economic landscape, marked by rising interest rates as central banks take measures to combat inflation. For instance, the U.S. Federal Reserve began raising interest rates in March 2022 after maintaining near-zero rates during the COVID-19 pandemic, hiking the interest rates 11 times up until January 2024 (Rodini, 2023). These rate hikes have led to higher borrowing costs, as well as having a broad impact on consumer spending and investment decisions. Investors, facing these changing conditions, are increasingly moving from stocks to bonds, seeking stability and better yields in a more predictable fixed-income market (J.P. Morgan Asset Management, 2024).

As interest rates rise, corporate bonds become more attractive to investors due to their higher yields and generally lower risk compared to comparable equities. They offer a reliable income stream and are seen as a safer investment during periods of economic uncertainty. This development has sparked our interest and motivation to study bond market dynamics, particularly the relationship between corporate bonds and various economic factors. With this in mind, we propose the following research question: "**How do interest rate hikes and other key economic variables influence the credit spreads of corporate bonds?"**

Corporate bonds are important in the financial ecosystem, providing a source of funding for businesses while offering investors an opportunity to earn returns. The credit spreads of these bonds, which represent the yield difference between corporate bonds and comparable maturity treasury bonds, reflect the additional risk investors bear when choosing corporate bonds over government securities. These spreads are influenced by several factors, including interest rates, inflation, GDP growth, and market volatility.

Our primary hypothesis implies that interest rate hikes significantly increase credit spreads. To test this, we will employ fixed effects regression models that incorporate a rate hike dummy variable alongside other economic indicators.

By analyzing these variables, we aim to isolate the specific impact of rate hikes on credit spreads and understand the broader market dynamics.

In summary, this thesis aims to provide a comprehensive analysis of how interest rate hikes and other economic factors impact the credit spreads of corporate bonds. Through our analysis, we seek to contribute to existing knowledge and offer insights for stakeholders navigating the financial markets in times of rising interest rates.

1.1 Hypothesis

As outlined in the introduction, this study aims to examine the impact of interest rate hikes, as well as other key variables, on credit spreads in the bond market. Our main objective is to assess whether these periods of rate hikes significantly affect the credit spreads of corporate bonds. To do this, we base our study on the following main hypotheses:

1.1.1 Null Hypothesis

$\boldsymbol{H_0}: \beta_{Rate\ Hike\ Dummy} = 0$

The null hypothesis states that interest rate hikes have no significant, isolated effect on credit spreads. In other words, the rate hike dummy variable does not significantly influence the credit spreads of corporate bonds.

1.1.2 Alternative Hypothesis

$\boldsymbol{H_1}: \beta_{Rate\ Hike\ Dummy} \neq 0$

The alternative hypothesis implies that interest rate hikes do have a significant effect on credit spreads, meaning that the rate hike dummy variable significantly influences the credit spreads of corporate bonds. Specifically, we expected that interest rate hikes will increase credit spreads. This is because higher interest rates generally lead to higher borrowing costs and increased risk

premiums, which in turn widens the spread between corporate bond yields and risk-free rates.

By testing these hypotheses, we aim to determine whether periods of interest rate hikes by the Federal Reserve are associated with changes in credit spreads, thereby providing insights into the impact of monetary policy on the bond market.

2 Literature Review

2.1 Introduction to Bonds and Bond Pricing

A bond is a type of fixed-income investment where an investor lends money to a corporation or government for a set duration, usually receiving a fixed or variable interest rate in return. The issuer raises capital by selling bonds and agrees to pay the investor periodic interest, known as the coupon, and to repay the principal amount at maturity. Bonds issued by the U.S. government, such as Treasury bonds, are considered safe investments due to the minimal risk of default, as they are backed by the government's ability to levy taxes. However, bond prices can fluctuate significantly due to changes in interest rates and other economic factors, impacting their return on investment (Veronesi, 2010).

Companies issue corporate bonds to raise capital from investors. Unlike government bonds, which are issued by national or local governments, private and public corporations issue corporate bonds. These bonds usually provide higher yields than government bonds to offset the increased risk of default associated with corporate issuers. Corporate bonds come in various forms, including fixed-rate bonds, floating-rate bonds, and zero-coupon bonds. Companies issue corporate bonds to finance various business activities, such as expanding operations, funding research and development, or refinancing existing debts. By issuing bonds, companies can access funds without diluting ownership through equity issuance.

The pricing of bonds is influenced by a range of factors including interest rates, inflation expectations, and the issuer's creditworthiness. Changes in interest rates are particularly impactful; as rates rise, existing bond prices fall to align with new bonds issued at higher yields, and vice versa. This inverse relationship between bond prices and interest rates is a cornerstone of bond valuation and is fundamental to both investors and issuers (Fabozzi, 2007).

Credit risk also plays a significant role in bond pricing. Bonds issued by entities with higher credit ratings are perceived to have a lower risk of default, hence they offer lower yields compared to bonds issued by lower-rated entities. The expected default risk influences the yield spread between corporate bonds and risk-free Treasury bonds. Studies such as Elton et al. (2001) have shown that factors like expected default loss, state tax differences, and systematic risk factors significantly influence yield spreads between corporate bonds and Treasury bonds.

Liquidity is another critical factor. Less liquid bonds, which are harder to buy or sell without affecting their price, generally require a higher yield to attract investors. Huang and Huang (2003) highlight that liquidity premia can significantly impact yield spreads, especially for investment-grade bonds. This liquidity premium compensates investors for the additional risk associated with holding assets that are less liquid.

In summary, bond pricing is a multifaceted process influenced by interest rates, credit risk, and liquidity. Understanding these factors is essential for making informed investment decisions and managing risks in the bond market.

2.2 Credit Spreads

2.2.1 Liquidity Premia

Liquidity premia are a crucial factor in determining credit spreads, reflecting the additional yield investors demand to compensate for the risk of holding assets with lower liquidity. Bonds with lower liquidity are harder to buy or sell without significantly affecting their prices, increasing the risk for investors. Huang and Huang (2003) provide a comprehensive analysis of the role of liquidity premia in the corporate bond market, finding that liquidity premia play a substantial role in yield spreads, particularly for investment-grade bonds. According to their study, credit risk accounts for approximately 20% of yield spreads for investment-grade bonds and up to 30% for high yield bonds, with the remaining portion mainly attributed to liquidity premia.

Chen, Lesmond, and Wei (2007) further investigate the relationship between corporate yield spreads and bond liquidity, using various proxies such as bid-ask spreads and trading volume to capture various aspects of liquidity. They find that less liquid bonds, indicated by higher bid-ask spreads and lower trading volumes, are associated with higher yield spreads. This suggests that investors require a higher yield to compensate for the increased difficulty and cost associated with trading these bonds. The relationship between liquidity and yield spreads becomes even more pronounced during periods of market stress, such as the 2008 financial crisis, when liquidity concerns led to significant widening of yield spreads.

The importance of liquidity premia is also highlighted in studies like those by Bongaerts, de Jong, and Driessen (2017), which show that bonds with higher liquidity risk require higher yields. This reinforces the need to account for liquidity premia in bond pricing models. By incorporating liquidity risk into these models, investors can better assess the true cost of holding less liquid assets, aiding in evaluating the fair value of bonds and managing investment risks. The role of liquidity premia in credit spreads underscores the complexity

of bond pricing and the necessity of considering multiple factors to fully understand market dynamics.

2.2.2 Systematic Risk Factors

Systematic risk factors are crucial in understanding credit spread dynamics as they encompass market-wide risks that cannot be diversified away, such as interest rates, economic growth, inflation, and market volatility. Collin-Dufresne, Goldstein, and Martin (2001) highlight that traditional default risk models explain only a portion of the variation in credit spreads, with a significant part driven by a single systematic factor not captured by these models. This suggests the presence of market-specific supply and demand shocks, which play a substantial role in influencing credit spreads.

Elton et al. (2001) further underscores the importance of systematic risk factors by demonstrating that variables reflecting overall market risk, such as equity market returns and volatility, significantly affect the yield spreads between corporate and Treasury bonds. This finding highlights the interconnectedness of bond markets with broader financial markets and the economy, indicating that bond yields are influenced by broader economic conditions and investor sentiment.

Market volatility, particularly, has a notable impact on credit spreads. Studies like Bams and Honarvar (2021) show that during periods of high market volatility, indicated by the VIX index, investors demand higher risk premiums for holding corporate bonds, leading to wider credit spreads. Understanding these systematic risk factors is essential for a comprehensive analysis of bond pricing, as they provide a broader context for evaluating bond prices beyond issuer-specific risks, enabling more informed investment decisions.

2.2.3 Macroeconomic Variables

Macroeconomic variables significantly influence credit spreads by reflecting the broader economic environment in which bonds are issued and traded. Key variables include inflation rates, GDP growth, unemployment rates, and central bank policies, all of which affect investor sentiment and risk perceptions.

Inflation is a critical factor affecting credit spreads. Higher inflation expectations typically lead to higher interest rates as central banks tighten monetary policy, increasing the yield demanded by investors to compensate for the eroded purchasing power of future bond payments. Dupoyet, Jiang, and Zhang (2024) found a robust negative relationship between interest rates and credit spreads, highlighting the inverse impact of inflation and interest rates on bond prices.

GDP growth and unemployment rates are also significant indicators. Strong economic growth generally leads to narrower credit spreads due to reduced perceived default risk, while high unemployment rates can widen spreads due to increased uncertainty and higher default likelihood. Studies such as those by Elton et al. (2001) and Collin-Dufresne, Goldstein, and Martin (2001) demonstrate how economic conditions influence yield spreads.

Central bank policies, particularly interest rate decisions, directly impact credit spreads. When the Federal Reserve raises the Federal funds rate, borrowing costs increase, leading to wider credit spreads as investors demand higher yields. This effect is evident during periods of monetary tightening, where rate hikes result in significant adjustments in bond yields.

2.2.4 Credit Ratings

Credit ratings are a key determinant of credit spreads, reflecting the perceived risk of default by the bond issuer. Higher credit ratings indicate lower risk, resulting in narrower credit spreads, while lower ratings suggest higher risk and wider spreads. Campbell and Taksler (2003) demonstrated that bonds with

lower credit ratings required higher yields to compensate for the increased risk of default.

The relationship between credit ratings and yield spreads is further supported by empirical evidence from Chen, Lesmond, and Wei (2007). Their study shows that credit ratings not only influence the base yields but also interact with other factors such as liquidity, amplifying the overall effect on credit spreads. This underscores the importance of credit ratings in the bond market, as investors rely heavily on these ratings to assess the risk associated with different bonds.

Ericsson, Jacobs, and Oviedo (2005) investigate the relationship between credit default swap (CDS) premia and determinants such as firm leverage, volatility, and the risk-free interest rate. They find these variables significantly influence CDS premia, with an explanatory power of about 60% for levels of CDS premia and 23% for differences. This highlights the substantial role of leverage and volatility in determining credit spreads and underscores the need for comprehensive models that incorporate both market data and broader economic factors.

2.2.5 Interest Rates

Interest rates are a critical determinant of credit spreads, reflecting the cost of borrowing and the overall economic environment. Dupoyet, Jiang, and Zhang (2024) found a robust negative relationship between interest rates and credit spreads, consistent with Merton's (1974) structural model. As interest rates increase, credit spreads tend to decrease, and this effect is more pronounced for high-yield bonds compared to investment-grade bonds.

Changes in interest rates also influence the term structure of interest rates, or the yield curve, which indicates economic expectations. A steepening yield curve suggests future economic growth and inflation, leading to wider credit spreads, while a flattening or inverted yield curve may signal an economic

slowdown, potentially narrowing spread. These dynamics are crucial for understanding fluctuations in credit spreads over different economic cycles.

Interest rate hikes by central banks significantly impact credit spreads by altering market liquidity and risk perceptions. During period of monetary tightening, the increase in short-term interest rates often leads to a reduction in market liquidity, as higher borrowing costs discourage lending and investment. This reduced liquidity tends to widen credit spreads, as investors require higher yields to compensate for the increased difficulty of trading in a less liquid market. Longstaff and Schwartz (1995) demonstrated that interest rate volatility, particularly around periods of policy changes, influences credit spreads, with higher volatility leading to wider spreads.

Moreover, interest rate hikes can lead to changes in investor behavior and risk appetite. As borrowing costs rise, the cost of capital for corporations increases, which can lead to a reassessment of credit risk and higher default probabilities. This increased perceived risk results in wider credit spreads, as investors demand higher compensation for the added risk. Estrella and Hardouvelis (1991) highlighted the predictive power of the yield curve slope for economic activity, linking it to variations in credit spreads. Their findings are particularly relevant when considering the effect of rate hikes, as these policy moves often lead to a flattening or inversion of the yield curve, indicating future economic slowdowns.

Building on these foundations, our study aims to extend this understanding by exploring the specific impact of interest rate hikes on credit spreads. By integrating the theoretical and empirical insights from previous research, we seek to provide a nuanced analysis that contributes to both academic literature and practical applications in the financial markets. Ultimately, we test whether rate hikes increase credit spreads due to heightened risk perception. The factors discussed in the literature review are incorporated to make our model more comprehensive and accurate. Our study will contribute to the literature by focusing specifically on periods of rising interest rates and employing a robust model to determine credit spreads.

3 Data

3.1 Data Collection and Preparation

3.1.1 Corporate Bond Data

In analyzing the American bond market, a key resource utilized is Wharton Research Data Services (WRDS), which provides access to extensive corporate bond data. WRDS sources its data from comprehensive databases like TRACE, which offers transaction details on U.S. corporate bonds. More specifically, we collect all variables from the “WRDS Bond Returns” dataset for the entire time series available at the time of conducting our research. Our sample period ranges from July 2002 to September 2022. This in turn allows us to test the corporate bond data on three different periods of major interest rate hikes.

For the sake of our research, we apply some filtering to the bond data. Firstly, we exclude bonds with a time to maturity of less than one year to eliminate short-term securities that are less sensitive to interest rate changes and might distort our analyses focused on longer-term market dynamics. In addition, we winsorize all variables except time to maturity and the numerical credit rating at the 5^{th} and 95^{th} percentile to deal with problematic outliers.

In our analysis, bonds are distinctly categorized into 'investment grade' and 'high yield' groups based on their credit ratings and categorization in the WRDS data, allowing for a nuanced examination of market behaviors under varying risk conditions. Investment grade bonds, denoted by higher credit ratings, are generally perceived as safer investments with lower yields, whereas high-yield bonds, with lower credit ratings, offer higher returns at a greater risk of default. Crucially, we exclude non-rated bonds from our dataset to maintain clarity and precision in our risk assessment. Additionally, bonds are further classified based on their time to maturity (TMT); those with TMT less than 15 years are considered short-term, while bonds with TMT of 15 years or more are classified as long-term. This distinction helps us explore differences in maturity

profiles and their respective responses to economic changes, particularly interest rate fluctuations. By focusing on rated bonds, our study adheres to a more standardized assessment of credit risk, facilitating a clearer, more consistent analysis of how credit ratings and maturity lengths influence bond market dynamics during periods of interest rate changes.

We also source independent variables in our regression from the WRDS dataset itself. This includes the numerical credit rating (RATING_NUM), the coupon, duration and the T spread. The numerical credit rating takes on a value between 1 and 22, where a lower value indicates a higher credit rating. Following the categorization in the dataset, investment grade bonds have ratings between 1 and 10, while high yield bonds have ratings between 11 and 22. This translates to ratings between AAA and BBB for investment grade, and between BB and D for high yield.

3.1.2 Yield Curve Data

To calculate the credit spreads for our corporate bond data as well as the yield curve slopes, we have collected yield curve data from Liu and Wu (2021). This dataset is an online repository of Treasury yield curves, derived using a novel non-parametric kernel-smoothing method from the CRSP Treasuries Time Series, updated and available on monthly and daily basis. The set covers a period from June 1961 to December 2022 at the time of writing. In our research we have used the monthly data as it matches with the frequency of our bond data, allowing us to calculate the credit spread for each bond data entry.

3.1.3 Data for Independent Variables

In our analysis, we utilize a variety of key economic indicators to ensure a robust examination of market dynamics. Most of our data, including the Federal Funds Effective Rate (FEDFUNDS), the Consumer Price Index for All Urban Consumers: All Items Less Food and Energy (CPILFESL), the

Unemployment Rate (UNRATE), and the Brave-Butters-Kelley Real Gross Domestic Product (BBKMGDP), are retrieved from the Federal Reserve Bank of St. Louis's FRED online database. The monthly-updated CBOE Volatility Index (VIX), which we use to capture the market's expected volatility, is sourced from Yahoo Finance (2024).

As all the data collected has entries on the first of the month, while our bond data is end-of-month, our independent variables are lagged by approximately one month. This is true for all independent variables not sourced from the WRDS Bond Returns dataset itself, namely the Brave-Butters-Kelley Real GDP, unemployment rate, federal funds rate and the VIX Index. The same goes for the inflation variable, only that it is constructed by calculating the inflation between the two-month and one-month ahead CPI less food and energy. The inflation, unemployment rate and federal funds rate variables are all denoted in percentage terms, which has implications for the interpretation of the results in our regressions, seeing as the credit spread is denoted in basis points.

3.2 Calculation of Key Variables

With all data collected, we start off with the construction of the dependent variable, the credit spread, which is essential for understanding the risk premium investors demand over the risk-free rate. For this purpose, we utilize the yield curve data sourced from Liu & Wu (2021).

To calculate the credit spread, we align each bond's yield to the nearest month's corresponding Treasury yield from the Liu & Wu (2021) data. This alignment involves rounding the time to maturity (TMT) of each bond to the nearest month, ensuring precision in matching the bond's yield to the appropriate risk-free rate provided by the Treasury yield for that maturity as well as converting the result to basis points. As a result, we define the spread as:

$$Credit\ Spread_{i,t} = Y_{i,t} - T_{i,t} \quad (1)$$

Where $Y_{i,t}$ = yield of bond i at time t and $T_{i,t}$ = Treasury yield corresponding to the rounded time to maturity for bond i at time t.

To visualize the credit spreads for our bonds, we calculate the average credit spread over time, differentiated by rating class:

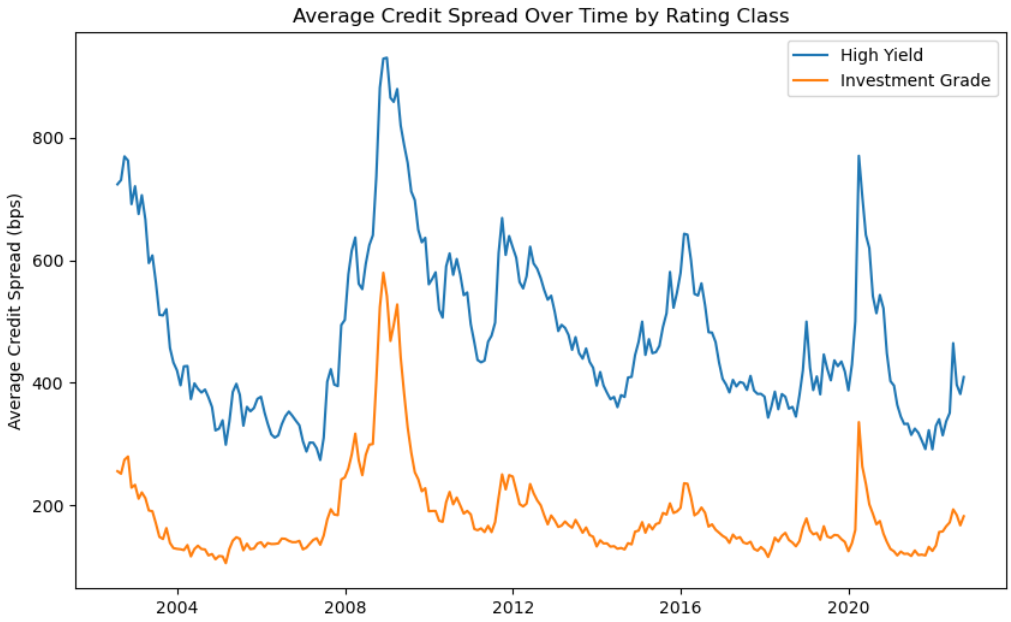

Figure 1: *Average credit spreads over the sample period for different risk profiles.*

Significant peaks in the credit spread are observed throughout, particularly during the financial crisis of 2008 and the more recent economic disruptions, such as the COVID-19 crisis. The graph effectively illustrates the fluctuations and trends in the credit spreads, providing insights into the changing market conditions and risk perceptions over the years.

To control for bond liquidity, we construct a turnover ratio as one of the independent variables in our model. It is constructed by dividing the amount outstanding of each bond by the total trading volume of that bond. This ratio provides a relative measure of how frequently the bond is traded in proportion

to its available quantity, offering insights into the market activity and liquidity for each bond:

$$Turnover\ ratio_{i,t} = \frac{AMOUNT\_OUTSTANDING_{i,t}}{T\_DVolume_{i,t}} \quad (2)$$

Where $AMOUNT\_OUTSTANDING_{i,t}$ represents the total nominal value of bond *i* that is in circulation at time *t* and $T\_DVolume_{i,t}$ equals the trading volume in dollars of bond *i* at time *t*, indicating how much of the bond was traded at that specific period.

A higher turnover ratio indicates lower liquidity, suggesting that a smaller proportion of the bond's total outstanding amount is traded frequently. Conversely, a lower turnover ratio indicates higher liquidity, reflecting a more active trading environment for the bond.

3.3 Summary Statistics

Table 1 provides a detailed summary of the key statistics for the investment grade bonds in our dataset, which includes 1,252,025 observations. The average time to maturity (TMT) is 11.16 years, with a significant range from 1 to 101.46 years, indicating a mix of both short-term and long-term bonds. The mean duration is 7.02 years, suggesting a moderate sensitivity to interest rate changes. The average credit spread is 158.51 basis points, with a considerable standard deviation of 121.72, highlighting the variability in risk premiums. Trading volume averages around $30.85 million, ranging widely from $51,044 to $173 million, showing varied liquidity levels. The credit ratings range from 1 to 10, with an average rating of 7.28, skewed towards lower-risk bonds. Additionally, the bonds exhibit a broad range in both coupon rates and amounts outstanding, reflecting the diversity in bond issuance within the investment grade category.

	TMT	Duration	RET L5M	RATING NUM	T Spread	T_DVolume	Credit Spread	Amount outstanding
Count	1249764	1252025	900756	1252025	1081499	1252025	1252025	1252025
Mean	11.16	7.02	0.63	7.28	0.63	30851799	158.51	519591.6
Std.	10.6	4.35	2.44	2.02	1.23	46593812	121.72	445947
Min	1	1.46	-2.95	1	0.04	51044	31.13	16860
10%	2.11	1.95	-1.76	5	0.08	145395.4	47.17	78000
25%	3.79	3.4	-0.41	6	0.19	1269941	76.4	233369
50%	7.35	6.02	0.34	8	0.39	9715705	122.05	400000
75%	17.51	10.52	1.37	9	0.76	37462114	195.12	700000
90%	26.34	13.89	2.92	10	1.4	1E+08	322.27	1250000
Max	101.46	15.82	100	10	200	1.73E+08	522.88	1750000
Skewness	2.53	0.59	6.16	-0.7	77.94	1.96	1.63	1.36
Median	7.35	6.02	0.34	8	0.39	9715705	122.05	400000

Table 1: *Summary statistics for the sample of investment grade bonds.*

Table 2 presents the key statistics for high yield bonds, consisting of 286,672 observations. These bonds have an average time to maturity (TMT) of 7.84 years, ranging from 1 to 96.72 years, indicating a wide diversity in maturity terms. The average duration is 4.96 years, showing moderate interest rate sensitivity. Compared to investment grade bonds, high yield bonds exhibit significantly higher credit spreads, averaging 535.88 basis points with a high standard deviation of 378.04, reflecting their higher risk premiums. Credit ratings range from 11 to 20, with an average of 13.73, indicating a skew towards higher credit quality within the high-yield category. Although trading volumes and amounts outstanding also show broad ranges, the high yield segment distinctly features greater risk and variability compared to investment grade bonds.

	TMT	Duration	RET L5M	RATING NUM	T Spread	T_DVolume	Credit Spread	Amount outstanding
Count	286373	286672	227386	286672	265833	286672	286672	286672
Mean	7.84	4.96	1.24	13.73	0.8	43160946	535.88	422811.7
Std.	7.18	2.33	5.19	2.15	1.59	53499522	378.04	330495.1
Min	1	1.55	-4.74	11	0.1	117572	166.02	25000
10%	2.41	2.1	-2.81	11	0.15	523785.1	208.06	90000
25%	4.02	3.27	-0.58	12	0.26	4741924	290.01	200000
50%	6.09	4.63	0.61	13	0.48	21711298	419.4	325000
75%	8.67	6.2	2.08	15	0.94	58943242	621.8	550000
90%	16.57	8.7	4.53	17	1.67	1.26E+08	1033.54	999370
Max	96.72	10.23	100	20	186.1	1.96E+08	1699.85	1300000
Skewness	4.67	0.66	7.29	0.57	40.4	1.63	1.81	1.21
Median	6.09	4.63	0.61	13	0.48	21711298	419.4	325000

Table 2*: Summary statistics for the sample of high yield bonds.*

4 Methodology

In our analysis, we utilize a panel regression model that incorporates a rate hike dummy variable to capture the impact of significant Federal Reserve interest rate increases on bond yields. This model also includes entity and quarterly fixed effects to control for industry-specific traits and macroeconomic dynamics, respectively. By integrating these variables, we aim to isolate the influence of broader economic factors on credit spreads, ensuring a precise and comprehensive analysis.

4.1 Rate Hike Dummy Variable

To capture the periods of significant interest rate increases by the Federal Reserve, we construct a rate hike dummy variable, which serves as the main variable of interest in our thesis. This variable identifies specific date ranges during which rate hikes occurred and sets the dummy variable to 1 for these periods. For our analysis, these periods include June 1, 2004, to July 31, 2006;

November 1, 2016, to January 31, 2019; and from February 1, 2022, onwards. Outside these date ranges, the dummy variable is set to 0, indicating no rate hikes. By focusing on this variable, we aim to isolate and analyze the direct impact of monetary policy changes on bond yields, providing a clearer understanding of how interest rate adjustments influence credit spreads. This approach allows us to control for the effects of rate hikes in our regression model, ensuring a more precise analysis of the determinants of bond yields.

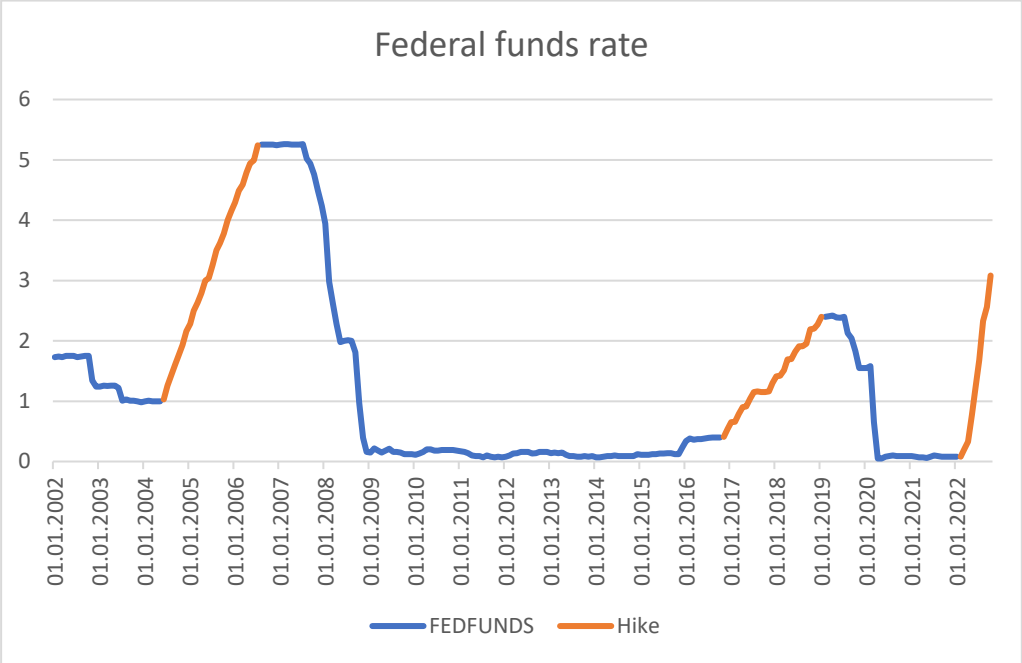

Figure 2: *Visualization of the US Federal Funds Rate over our sample period, constructed by using data from FRED (FEDFUNDS). The orange sections depicts where our rate hike variable takes on the value 1.*

4.2 Fixed Effects and Base Model

To control for intrinsic characteristics specific to each bond issuer, we introduce entity fixed effects based on the Standard Industrial Classification (SIC) codes. These codes categorize issuers into industries, capturing industry-specific traits that might influence bond yields, such as varying risk profiles, capital structures, and economic sensitivities (See Appendix A for all codes used). By including SIC codes as dummy variables in our regression model, we

can control for these industry-specific influences, allowing us to focus more precisely on how broader economic variables affect credit spreads. This approach effectively removes bias that could be introduced by unobserved, industry-specific factors, ensuring that the estimated effects of the independent variables are not confounded by these characteristics.

In addition to entity fixed effects, we incorporate quarterly fixed effects to account for macroeconomic and market dynamics that vary over time but are constant across entities within the same period. This inclusion is crucial given the potential impact of economic cycles, policy changes, and market sentiment shifts on bond yields. By controlling for these time-specific effects, we ensure that our model accounts for fluctuations in the economic environment that could influence all bonds regardless of their industry. The quarterly designation of these fixed effects allows for a detailed capture of temporal variations, aligning with the typical reporting and analysis cycles in financial markets.

Mathematically, these fixed effects are included in the regression model as a series of dummy variables—one for each SIC code and one for each quarter within the study period. Incorporating the fixed effects and the variables outlined above, we construct our regression model:

$$\begin{gathered} Credit\ Spread_{i,t} = \\ \beta_1 Inflation_t + \beta_2 BBK_{GDP_t} \\ +\beta_3 Unemployment\ rate_t + \beta_4 Federal\ funds\ rate_t \\ +\beta_5 VIX_t + \beta_6 Credit\ rating_i + \\ \beta_7 Coupon_{i,t} + \beta_8 Duration_{i,t} \\ +\beta_9 Hike\ Dummy_{i,t} + \beta_{10} Turnover\ ratio_{i,t} \\ +\beta_{11} T\ Spread_{i,t} + \gamma_t + \mu_i + \varepsilon_{i,t} \end{gathered} \tag{3}$$

4.3 Extended Model

To further refine our analysis of bond yields, we consider additional variables that capture the term structure of interest rates. Specifically, we introduce the concept of the yield slope, defined as the difference between the yields of bonds maturing in 120 months and those maturing in 24 months in basis points. This measure, outlined below, assists in understanding the yield curve's behavior and its implications for bond pricing and credit risk:

$$Yield\ slope_{i,t} = Y_{120m_{i,t}} - Y_{24m_{i,t}} \tag{4}$$

By incorporating this yield slope into our regression model, we aim to enhance our analysis by examining how changes in the term structure affect credit spreads. This leads to the formulation of an expanded regression model, which builds upon the original model in Equation (3):

$$\begin{gathered} Credit\ Spread_{i,t} = \\ \beta_1 Inflation_t + \beta_2 BBK_{GDP\,t} \\ +\beta_3 Unemployment\ rate_t + \beta_4 Federal\ funds\ rate_t \\ +\beta_5 VIX_t + \beta_6 Credit\ rating_i + \\ \beta_7 Coupon_{i,t} + \beta_8 Duration_{i,t} \\ +\beta_9 Hike\ Dummy_{i,t} + \beta_{10} Turnover\ ratio_{i,t} + \beta_{11} Yield\ slope_{i,t} \\ +\beta_{11} T\ Spread_{i,t} + \gamma_t + \mu_i + \varepsilon_{i,t} \end{gathered} \tag{5}$$

By employing two different models, with the only difference being the inclusion of the yield slope variable, we can isolate the specific effects of the term structure of interest rates on credit spreads. This approach allows us to first establish a baseline understanding with the simpler model, and then measure the additional explanatory power provided by the yield slope in the extended model. Comparing the results from both models helps validate the robustness of our findings, highlighting the significance of considering the

term structure in credit spread analysis and ensuring that our conclusions are both precise and reliable.

5 Results

In this section, we present the findings from our analysis of the predictive power of bond market dynamics and interest rate changes.

Our research investigates the determinants of credit spread changes for bonds during periods of rising interest rates. Using a comprehensive dataset of bond yields and various economic indicators, we employ regression models to identify the significant factors influencing credit spreads.
We analyzed the impact of various economic indicators on credit spreads for both short-term and long-term bonds. Table 3 summarizes the regression results for investment-grade and high-yield bonds. This analysis was conducted for the entire sample period from July 2002 to September 2022. Additionally, we separately analyzed investment-grade and high-yield bonds to understand the distinct behaviors under varying risk conditions. The adjusted R-squared values are included as indicators of the performance of the different models, demonstrating how well the independent variables explain the variation in credit spreads. The number of observations is also provided, reflecting the robustness and comprehensiveness of our dataset.

5.1 All bonds in sample

	Short term		Long term	
Model	(1)	(2)	(3)	(4)
Inflation	-1.847	5.879***	-16.723***	7.660
Brave-Butters-Kelley Real GDP	-0.563***	-0.651***	-0.060	-0.320***
Unemployment rate	6.346***	4.888***	8.911***	4.874***
Federal funds rate	-30.730***	-35.251***	-26.950***	-40.954***
VIX Index	3.035***	3.026***	2.659***	2.621***
Credit Rating (Numeric)	36.156***	36.155***	39.076***	39.056***
Coupon	14.664***	14.665***	-6.298***	-6.470***
Duration	6.974***	6.973***	-21.060***	-21.208***
Rate hike dummy	7.042***	6.628***	0.263	-1.852
Turnover ratio	3.283***	3.295***	5.191***	5.185***
T spread	8.375***	8.386***	30.703***	30.696***
Yield slope		-0.156***		-0.469***
Adjusted R-squared	0.691	0.691	0.413	0.413
Number of observations	1 082 046	1 082 046	308 913	308 913

Note: Levels of significance = *10%, **5%, ***1%

Table 3*: Regression results for all bonds in our sample*

The results provide insights into the factors influencing credit spreads in both the short term and long term over the whole sample. The rate hike dummy shows a significant positive effect on credit spreads in the short-term models (1) and (2), indicating that periods of interest rate hikes are associated with higher credit spreads in the short run. Specifically, the rate hike dummy coefficients are 7.042 and 6.628, both significant at the 1% level, supporting our hypothesis that interest rate hikes increase credit spreads due to heightened risk perception and borrowing costs. However, in the long-term models (3) and (4), the rate hike dummy is not significantly different from zero, suggesting that the immediate impact of rate hikes is more pronounced in the short term rather than over longer maturities. This divergence underscores the importance of distinguishing between short-term and long-term effects in our analysis. Overall, these findings validate our hypothesis in the short term and highlight the dynamic nature of credit spread determinants over different time horizons.

Table 3 demonstrates significance with a high adjusted R-squared value of 0.693 for short-term bonds, indicating that the model explains a substantial

portion of the variability in credit spreads. The adjusted R-squared values for long-term bonds indicate a less strong model fit compared to short-term bonds, suggesting that long-term credit spreads might be influenced by additional factors not captured in the model. Inflation is not significant in model (1) without the yield slope but becomes significant and positive in model (2). For long-term bonds, inflation is significant in model (3) but loses significance when the yield slope is added in model (4). These mixed results suggest that inflation's direct effect on credit spreads is difficult to interpret and might be less relevant when considering the term structure of interest rates captured by the yield slope.

The Brave-Butters-Kelley Real GDP is significant in models (1), (2), and (4), indicating that real GDP changes have a direct impact on credit spreads in these contexts. This suggests that macroeconomic factors included in the model play a pivotal role in determining credit spreads, with real GDP changes having a negative effect on credit spreads. The VIX index shows a positively significant impact on credit spreads, suggesting that higher levels of market volatility lead to wider credit spreads. This implies that during periods of increased uncertainty and market turbulence, investors demand higher risk premiums for holding corporate bonds to compensate for the additional risk. The significance of the VIX index highlights the role of market sentiment and perceived risk in determining the pricing of corporate bonds. The federal funds rate has a significant negative impact on credit spreads across all models, indicating that higher federal funds rates are associated with narrower credit spreads. This inverse relationship can be explained by the fact that higher federal funds rates generally signal tighter monetary policy, which can reduce inflation expectations and economic uncertainty, thereby lowering the risk premiums that investors demand for holding corporate bonds relative to risk-free treasury bonds.

Credit rating is a significant determinant of credit spreads, with higher numeric values indicating lower credit ratings associated with wider credit spreads. This positive relationship highlights that lower credit ratings are linked to higher perceived risk, leading investors to seek higher yields as compensation for this increased risk. This result underscores the importance of creditworthiness in

the bond market. The turnover ratio is also significant in determining credit spreads. A higher turnover ratio is associated with wider credit spreads, as investors require a premium to compensate for the difficulty in buying or selling the bonds without significantly affecting their price. The significance of the turnover ratio emphasizes the impact of liquidity risk on bond pricing, showing that less liquid bonds are generally more expensive to trade and thus require higher yields.

Overall, these findings demonstrate the robustness of our model in capturing the multifaceted influences on credit spreads. By incorporating a comprehensive set of variables, our analysis provides a nuanced understanding of how various economic indicators and market conditions impact bond pricing, reinforcing the importance of considering multiple factors in credit spread analysis. This comprehensive approach not only validates our hypotheses but also aligns with established research, offering valuable insights for investors and policymakers alike.

5.2 Investment grade bonds

	Short term		Long term	
Model	(5)	(6)	(7)	(8)
Inflation	-3.664***	0.908	-13.032***	5.912**
Brave-Butters-Kelley Real GDP	-0.482***	-0.532***	-0.032	-0.227***
Unemployment rate	5.570***	4.765***	5.069***	2.166***
Federal funds rate	-22.574***	-25.206***	-16.813***	-27.468***
VIX Index	2.111***	2.105***	2.392***	2.357***
Credit Rating (Numeric)	17.082***	17.080***	19.734***	19.721***
Coupon	11.718***	11.718***	-5.674***	-5.814***
Duration	8.754***	8.753***	-18.863***	-18.979***
Rate hike dummy	9.006***	8.700***	1.596	0.003
Turnover ratio	7.147***	7.154***	1.185***	1.181***
T spread	5.412***	5.424***	10.821***	10.846***
Yield slope		-0.090***		-0.351***
Adjusted R-squared	0.587	0.587	0.502	0.503
Number of observations	836 136	836 136	280 795	280 795

Note: Levels of significance = *10%, **5%, ***1%

Table 4*: Regression results for investment grade bonds only.*

The results for investment-grade bonds exhibit several notable similarities and differences compared to the overall findings. The rate hike dummy remains significant in the short-term models (5) and (6), with coefficients of 9.006 and 8.700, respectively, both significant at the 1% level. This again reinforces our hypothesis that interest rate hikes lead to higher credit spreads. However, similar to the previous results, the rate hike dummy is not significant in the long-term models (7) and (8).

While the general trend of the variables remains consistent with the overall sample, some differences are noteworthy. For instance, inflation shows a significant negative impact in the short-term model (5) but loses significance in model (6) when the yield slope is included. In contrast, inflation is significant and positive in the long-term model (8), which diverges from the mixed results observed in the overall findings. The Brave-Butters-Kelley Real GDP remains significant in the short-term models (5) and (6) and in the long-term model (8), indicating that real GDP changes have a pronounced impact on credit spreads in these contexts.

The federal funds rate continues to show a significant negative impact across all models, reaffirming the inverse relationship between interest rates and credit spreads. This consistency underscores the robustness of our model in capturing the effects of monetary policy on bond pricing. The VIX Index, credit rating, coupon, and duration variables maintain their significance across the models, highlighting their critical roles in determining credit spreads. The turnover ratio also remains significant, emphasizing the importance of liquidity in bond pricing.

It is also observed that most of the coefficients for investment-grade bonds are less pronounced compared to the overall sample. Negative coefficients are less negative, and positive coefficients are less positive. This makes sense because the exclusion of high-yield bonds, which tend to have more extreme values, results in less pronounced coefficients for the investment-grade segment.

5.3 High yield bonds

	Short term		Long term	
Model	(9)	(10)	(11)	(12)
Inflation	-0.320	30.475***	-45.658	-6.445
Brave-Butters-Kelley Real GDP	-0.896***	-1.314***	-0.847	-1.634**
Unemployment rate	8.936***	1.286	19.932	2.477
Federal funds rate	-71.212***	-90.641***	-121.983***	-155.604***
VIX Index	6.732***	6.703***	5.624***	5.766***
Credit Rating (Numeric)	74.694***	74.710***	53.375***	53.396***
Coupon	23.413***	23.401***	-25.471***	-25.529***
Duration	-8.215***	-8.196***	-118.779***	-118.780***
Rate hike dummy	-4.714	-4.561	-18.568	-23.134
Turnover ratio	41.136***	41.060***	25.287***	25.143***
T spread	28.658***	28.629***	70.310***	69.832***
Yield slope		-0.689***		-1.270***
Adjusted R-squared	0.570	0.571	0.493	0.494
Number of observations	243 664	243 664	27 763	27 763

Note: Levels of significance = *10%, **5%, ***1%

Table 5*: Regression results for high yield bonds only.*

The regression results for high yield bonds, as shown in Table 5, reveal several key insights, particularly regarding the effect of the rate hike dummy variable. Unlike the overall sample and investment-grade bonds, the rate hike dummy is not significant in any of the high yield bond models, whether in the short term (models (9) and (10)) or the long term (models (11) and (12)). As a result, we cannot reject the null hypothesis for any of the models. This lack of significance suggests that periods of Federal Reserve interest rate hikes do not have an isolated or direct effect on the credit spreads of high yield bonds. This finding is interesting because it contrasts with the results observed for investment grade bonds, where interest rate hikes had a notable short-term impact on credit spreads. This also highlights that the significance of our dummy variable in the overall results is highly affected by the investment grade sample, as the number of observations is much higher than that for the high yield bonds.

Additionally, the coefficients for the high yield bonds are more pronounced than those for the investment grade bonds. For example, the coefficient for the

Federal funds rate is significantly more negative, indicating a stronger inverse relationship with credit spreads in high yield bonds. This is consistent with the expectation that high yield bonds, being riskier, are more sensitive to changes in economic conditions and monetary policy. The coefficients for the VIX Index and Credit Rating are also notably higher, reflecting the higher sensitivity of high yield bonds to market volatility and credit risk.

5.4 Robustness test

In this section, we discuss the regression results presented in the main analysis and compare them with the robustness checks included in the appendix (See Appendix B, C and D). The robustness checks involved excluding the final crisis months and the COVID-19 period (March and April 2020) to validate the consistency and reliability of our initial findings.

The robustness checks reveal several important insights. Firstly, the significance and direction of key variables, such as the federal funds rate, VIX index, and credit rating, remain consistent with the initial results. This consistency reinforces the robustness of our model in capturing the essential determinants of credit spreads. Additionally, the adjusted R-squared values in the robustness checks are comparable to those in the initial results, indicating similar explanatory power of the models.

For short-term models, inflation remains insignificant in the robustness checks for short-term bonds without the yield curve, aligning with the initial results. However, when the yield curve is added, inflation becomes significant, consistent with the initial findings. The rate hike dummy retains its significance, indicating a positive impact on credit spreads in short-term models for investment-grade bonds. This supports the hypothesis of an immediate effect of interest rate hikes on credit spreads. In the long-term models, inflation shows mixed results, similar to the initial findings. It is significant in some models but not in others, indicating its variable impact over different periods. The rate hike dummy remains insignificant for long-term

models, consistent with the initial conclusion that the impact of rate hikes diminishes over time.

The robustness checks for investment-grade bonds largely mirror the initial results, with significant coefficients for the federal funds rate, VIX index, and other critical variables. For high-yield bonds, the robustness checks confirm the lack of significance for the rate hike dummy, highlighting the differential impact of economic variables on bonds of varying credit quality.

In conclusion, the robustness checks affirm the reliability and consistency of our initial regression results. The key determinants of credit spreads—such as the federal funds rate, VIX index, and credit rating—consistently exhibit significant impacts across different periods and bond types. These findings underscore the robustness of our test results and provide valuable insights for investors and policymakers, highlighting the complex interplay between economic conditions and bond market dynamics.

6 Conclusion

This study examined the effects of interest rate movements on credit spreads in bonds prices as well some key economic variables. Secondarily, we aimed to analyze whether the credit spreads of corporate bonds have been strongly affected by periods of rate hikes and learn about how monetary policy is transmitted into this segment.

Our findings indicate that the rate hike dummy variable has a significant positive effect on credit spreads in the short-term models for the overall sample and investment-grade bonds. This supports our alternative hypothesis, suggesting that interest rate hikes lead to higher credit spreads in the short run due to heightened risk perception and increased borrowing costs. Conversely, the lack of significance in the long-term models suggests that the immediate impact of rate hikes diminishes over time, highlighting the transient nature of these effects.

Interestingly, the analysis of high yield bonds revealed that the rate hike dummy variable was not significant in any of the models, whether in the short term or long term. This indicates that interest rate hikes do not have an isolated or direct effect on the credit spreads of high yield bonds. This divergence between high yield and investment-grade bonds underscores the necessity of considering bond class distinctions when evaluating the impacts of monetary policy changes.

The consistent significance of other variables, such as the VIX index, credit rating, coupon, duration, and turnover ratio, across most models emphasizes their crucial roles in determining credit spreads. The federal funds rate's negative relationship with credit spreads further underscores the complex dynamics between monetary policy and market conditions.

These results enhance our understanding of how various economic indicators and market conditions affect corporate bonds. While the short-term impact of interest rate hikes on credit spreads is clear for investment-grade bonds, the absence of a similar effect on high yield bonds suggests that additional factors may moderate this relationship in the high yield segment.

The robustness checks affirm the reliability and consistency of our initial regression results. The key determinants of credit spreads—such as the federal funds rate, VIX index, and credit rating—consistently exhibit significant impacts across different periods and bond types. Inflation remains insignificant for short-term bonds without the yield curve, but becomes significant when the yield curve is included, consistent with the initial results.

It is important to acknowledge the limitations of this study, including its focus on a specific context and sample, which may affect the generalizability of the findings. Additionally, external factors not accounted for in this research, such as regulatory changes and technological advancements, could influence the relationship between interest rate hikes and credit spreads. Future research should continue to explore these dynamics, considering a broader range of factors and contexts to build a more comprehensive understanding of credit spread determinants and their implications for financial markets.

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Appendix

Appendix A*: SIC Codes present in the sample and for the fixed effects in the regression.*

Two-digit SIC code	Industry
10	Metal Mining
12	Coal Mining
13	Oil and Gas Extraction
14	Mining and Quarrying of Nonmetallic Minerals, Except Fuels
15	Building Construction - General Contractors & Operative Builders
16	Heavy Construction Other Than Building Construction Contractors
17	Construction - Special Trade Contractors
20	Food and Kindred Products
21	Tobacco Products
22	Textile Mill Products
23	Apparel and Other Finished Products Made from Fabrics and Similar Materials
24	Lumber and Wood Products, Except Furniture
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing, Publishing, and Allied Industries
28	Chemicals and Allied Products
29	Petroleum Refining and Related Industries
30	Rubber and Miscellaneous Plastics Products
31	Leather and Leather Products
32	Stone, Clay, Glass, and Concrete Products
33	Primary Metal Industries
34	Fabricated Metal Products, Except Machinery and Transportation Equipment
35	Industrial and Commercial Machinery and Computer Equipment
36	Electronic and Other Electrical Equipment and Components, Except Computer Equipment
37	Transportation Equipment
38	Instruments and Related Products
39	Miscellaneous Manufacturing Industries
40	Railroad Transportation
41	Local and Suburban Transit and Interurban Highway Passenger Transportation
42	Motor Freight Transportation and Warehousing
44	Water Transportation
45	Transportation by Air
46	Pipelines, Except Natural Gas
47	Transportation Services
48	Communications
49	Electric, Gas and Sanitary Services
50	Wholesale Trade - Durable Goods
51	Wholesale Trade - Nondurable Goods
52	Building Materials, Hardware, Garden Supply, and Mobile Home Dealers
53	General Merchandise Stores
54	Food Stores
55	Automotive Dealers and Gasoline Service Stations
56	Apparel and Accessory Stores
57	Home Furniture, Furnishings, and Equipment Stores
58	Eating and Drinking Places
59	Miscellaneous Retail
60	Depository Institutions
61	Non-Depository Credit Institutions
62	Security and Commodity Brokers, Dealers, Exchanges, and Services
63	Insurance Carriers
64	Insurance Agents, Brokers, and Service
65	Real Estate
67	Holding and Other Investment Offices
70	Hotels, Rooming Houses, Camps, and Other Lodging Places
72	Personal Services
73	Business Services
75	Auto Repair, Services, and Parking
78	Motion Pictures
79	Amusement and Recreation Services
80	Health Services
82	Educational Services
83	Social Services
87	Engineering, Accounting, Research, Management, and Related Services
99	Nonclassifiable Establishments

Appendix B*: Regression result for the total sample, for robustness test purposes.*

	Short term		Long term	
Model	(1)	(2)	(3)	(4)
Inflation	3.261	8.472***	-17.778***	-0.864
Brave-Butters-Kelley Real GDP	-0.360***	-0.416***	-0.112	-0.273***
Unemployment rate	7.245***	5.750***	9.642***	5.042***
Federal funds rate	-21.580***	-25.049***	-42.665***	-53.653***
VIX Index	2.584***	2.564***	2.656***	2.574***
Credit Rating (Numeric)	36.247***	36.246***	38.871***	38.845***
Coupon	14.639***	14.640***	-6.250***	-6.456***
Duration	6.489***	6.487***	-21.262***	-21.442***
Rate hike dummy	2.887***	3.860***	-3.684	-0.534
Turnover ratio	3.583***	3.594***	5.589***	5.571***
T spread	8.111***	8.121***	28.633***	28.626***
Yield slope		-0.144***		-0.471***
Adjusted R-squared	0.693	0.693	0.419	0.420
Number of observations	1 030 986	1 030 986	290 607	290 607

Note: Levels of significance = *10%, **5%, ***1%

Appendix C*: Regression result for investment grade bonds, for robustness test purposes.*

	Short term		Long term	
Model	(5)	(6)	(7)	(8)
Inflation	0.133	3.032**	-12.363***	0.615
Brave-Butters-Kelley Real GDP	-0.306***	-0.335***	-0.138***	-0.253***
Unemployment rate	6.231***	5.423***	7.048***	3.719***
Federal funds rate	-13.669***	-15.558***	-20.559***	-28.644***
VIX Index	1.696***	1.684***	2.232***	2.161***
Credit Rating (Numeric)	17.015***	17.013***	19.674***	19.658***
Coupon	11.732***	11.732***	-6.135***	-6.302***
Duration	8.384***	8.382***	-19.394***	-19.535***
Rate hike dummy	5.310***	5.855***	-3.100**	-0.594
Turnover ratio	7.234***	7.241***	1.349***	1.334***
T spread	5.215***	5.227***	10.479***	10.505***
Yield slope		-0.080***		-0.350***
Adjusted R-squared	0.587	0.587	0.499	0.500
Number of observations	792 086	792 086	263 163	263 163

Note: Levels of significance = *10%, **5%, ***1%

Appendix D: *Regression result for high-yield bonds, for robustness test purposes.*

	Short term		Long term	
Model	(9)	(10)	(11)	(12)
Inflation	-1.019	23.912***	-67.147	-36.885
Brave-Butters-Kelley Real GDP	-0.397**	-0.749***	-2.423***	-3.218***
Unemployment rate	9.082***	1.001	35.295**	17.271
Federal funds rate	-63.627***	-81.491***	-119.672***	-153.15***6
VIX Index	5.973***	5.915***	5.404***	5.541***
Credit Rating (Numeric)	74.752***	74.767***	51.245***	51.248***
Coupon	23.508***	23.495***	-26.453***	-26.545***
Duration	-8.581***	-8.563***	-117.912***	-117.953***
Rate hike dummy	-6.119	-1.629	-19.939	-17.711
Turnover ratio	43.764***	43.669***	22.835***	22.675***
T spread	28.123***	28.093***	69.765***	69.277***
Yield slope		-0.690***		-1.303***
Adjusted R-squared	0.571	0.571	0.495	0.496
Number of observations	236 729	236 729	27 099	27 099

Note: Levels of significance = *10%, **5%, ***1%