Corporate Bond Yield Spreads: A Search-based Sentiment Approach

Johan Pettersson* & Christoffer Sjöström**

May 15, 2016

Bachelor Thesis

Department of Finance

Stockholm School of Economics

Abstract

This study examines the effect of investor sentiment, as measured by internet search activity, on corporate bond yield spreads. Specifically, we predict systematic reversal patterns as a result of sentiment-induced mispricing: In pessimistic regimes bonds appear underpriced with higher yields than indicated by fundamental values. Subsequently, delayed price correction neutralizes irrational deviations. We also expect that high-yield issues, who are more likely to be affected by subjective valuations and limits to arbitrage, are more sensitive to changes in investor sentiment and are characterized by more pronounced reversal patterns. However, our results are neither statistically nor economically significant, providing no support for the role of investor sentiment in this context. These findings apply to a series of re-specifications with regard to our measure of sentiment. Nevertheless, these findings might prove valuable as they possibly indicate that corporate bonds display inertia in the incorporation of sentiment relative to stocks.

Keywords: Investor sentiment, Corporate bonds, Yield spreads, Mispricing, Reversal trends

Thesis Advisor: Irina Zviadadze

Acknowledgements: We would like to thank Irina Zviadadze for valuable input and support

*22985@student.hhs.se

** 22997@student.hhs.se

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1 Introduction

Conventional financial theory ignores the effect of individual decision making in explaining several asset pricing phenomena. Rather it argues that investors process information perfectly and therefore infer optimal statistical distributions about expected portfolio returns. Competition among rational investors thus gives rise to an equilibrium, in which prices of securities mirror rationally discounted values based on fundamental values of risk. Even though traditional financial theory acknowledges the presence of irrational investors making inconsistent or systematically suboptimal investment decisions, it predicts that their actions will be mitigated and fully undone by rational arbitrageurs. Given this framework, there is no room for the role of investor sentiment. Behavioural finance challenges this view by asserting that arbitrage activity may practically be limited and market participants may assess information erroneously. In line with this, a wide range of authors (De Long et al. 1990; Shleifer and Vishny 1997) document that both cross-sectional and time-series return patterns significantly deviate from rational predictions. This has rendered a growing attraction to behavioral biases in describing several market anomalies. Biased investor outlooks represent such an aspect and has been at the very centre and forefront of research within behavioural finance.

Comprehensive research shows that investor sentiment, which is commonly defined as the general level of optimism or pessimism in the market, has significant effects on stock returns over different specifications of time horizons (Baker and Wurgler 2006; Neal and Wheatley 1998; Da et al. 2014; Qiu and Welch 2004 etc). Even though sentiment is commonly believed to have pervasive influence on a wide range of assets, relatively little has been documented in corporate bond markets. Previous work has manifested the impact of sentiment on corporate bond yield spreads over the long-term and have in common the usage of the same sentiment measure. Drawing from this, our study uniquely builds upon and extends previous findings by (1) adopting an alternative search-based approach in capturing market pessimism and (2) by considering shorter time periods.

Based on the great amount of sentiment literature, our study predicts that increased market pessimism is associated with overestimation of underlying risks contemporaneously, whereas subsequent delayed price correction gives rise to systematic reversal patterns. Accordingly we test and postulate the following hypothesis: In periods of pessimism, contemporaneous yield spreads are high. After periods of pessimism, subsequent yield spreads are low. Additionally, we expect that bonds more prone to subjective valuations and limits to arbitrage are more susceptible to shocks in investor sentiment, being marked by more erroneous mispricing and

distinct trends. Therefore, we also hypothesize that: The relation between investor pessimism and yield spreads is more pronounced for high-yield bonds with distressed attributes.

We empirically test our theoretical predictions by establishing the leading and current relationship between corporate bond yield spreads and sentiment through conducting regressions for a wide range of different sub-samples using data from 2004-2014. The classification of categories relies upon observed trends in yield spreads and includes different ratings, maturities and industries. Our results are generally both economically and statistically insignificant, not lending any support for our initial hypotheses of systematic reversals. These findings remain robust to a wide range of alternate specifications of the sentiment index, time horizons and sub-periods. Given that the search-based measure reflects sentiment and that there are no systematic reversals, our results might indicate that bonds incorporate sentiment at a slower rate relative to stocks. This is broadly consistent with previous documentations on direct spillovers between debt and equity markets with stocks leading bonds in the reflection of information and that bonds depict considerably limited liquidity.

The outline of the remainder of the study is organized as follows: Section 2 reviews previous literature. Section 3 describes the data used in the study. Section 4 discusses key theoretical concepts underlying our hypotheses and presents our methodology. Section 5 demonstrates and analyzes obtained empirical results. Section 6 discusses alternative interpretations of our findings and the limitations inherent in our study. Section 7 concludes and provides suggestions for future research

2 Previous Literature

This section reviews prior literature on the topic and identifies how our study uniquely builds on previous findings. First, investor sentiment is discussed in the context of financial theory. Then, several common sentiment proxies are described. Finally, documentations of sentiment in both debt and equity markets are presented.

2.1 Behavioural Finance and Investor Sentiment

Behavioural finance builds upon the principle of limits to arbitrage, stating that the presence of arbitrage constraints may hinder rational arbitrageurs from bringing prices back to intrinsic value. In support of this, Shleifer and Vishny (1997) demonstrate that specialized performance-based arbitrage may not be sufficient in forcing security prices to fundamental values, particularly in several extraordinary circumstances. Additionally, De Long et al. (1990) present a simple generations model picturing an asset market in which irrational noise traders with

erroneous stochastic beliefs both affect prices and earn abnormally positive expected returns, creating an embedded risk associated with unpredictability of the noise traders that serves as a deter for rational arbitraguers to bet against them. As a result, prices can deviate significantly from fundamentals even when risk is absent.

While the efficient market hypothesis claims that asset prices reflect all publicly available information to investors (Fama and Malkiel, 1970), behavioural finance suggests that investors do not always process information correctly. Imperfect processing of information among investors might render misestimation of potential events and associated cash flows. Behavioral biases due to erroneous assessment of information has been unveiled in a range of influential papers. For instance, Kahneman and Tversky (1972, 1973) conduct a series of experiments claiming that decision makers unproportionately focus on recent beliefs compared to previous perceptions in the establishment of market forecasts. Kahneman and Tversky (1972, 1973) also show that people tend to conduct exaggerated market forecasts given the degree of uncertainty embedded in the material. Analogous to these findings, De Bondt and Thaler (1990) explain the P/E-effect by extreme earnings expectations based on recent abnormal performance. Similarly, Ball and Brown (1968) were among the pioneers in showing evidence of drifting stock prices after earning announcements.

Given the setting that behavioural finance brings forth, investor sentiment is allowed to have pervasive influence on asset prices and bears the possibility of explaining various anomalies in financial markets consistent with previous findings on the topic.

2.2 Sentiment Measures

Investor sentiment is considered to have permeating effects on asset prices, yet there is no consensus among practitioners of how it should be measured properly (Da et al., 2014). This subsection aims to briefly discuss and present some of the existing measures and their properties given in the vast amount of sentiment literature.

Perhaps the most popular proxy of investor sentiment is put forward by Baker and Wurgler (2006), hereafter BW. The authors form a joint index based on the common variation in a number of sentiment proxies represented by different underlying market variables. Specifically, these are the NYSE share turnover, the closed-end fund discount, the average first day-returns and number of IPOs, the dividend premium on equity holdings and the equity share in new issues. The closed-end fund discount is the difference between net asset values of closed-end stock fund shares and the corresponding market prices and is claimed to be inversely associated with sentiment according to Zweig (1973). Baker and Stein (2004) argue that share

turnover can serve as a sentiment indicator and Jones (2002) claim that high turnover, or alternatively liquidity, renders low market returns. According to BW (2006) the IPO market is affected by sentiment, with abnormal performance on initial returns being connected to optimism. The share of equity issues divided by the total amount of equity is also argued to have a linkage to sentiment since high values of equity shares generates to low market returns, as proposed by BW (2000). BW (2004) advocates the inclusion of a dividend premium as a means of measuring sentiment as it captures relative investor demand for dividend-paying stocks.

Another market-based variable that has gained a foothold as a signal of sentiment is the put-call ratio, which is the ratio of outstanding put options to outstanding call options (Bodie et al., 2010). Because higher values of call options depend on rising markets, whereas the opposite holds for puts, deviations might forecast return movements. Simon and Wiggins (2001) investigates the forecasting power for subsequent returns on S&P 500 futures contracts over shorter horizons, using the volatility index, the put-call ratio and the trading index (TRIN). They find that these variables are contrarian indicators and that they frequently appear significant both economically and statistically. We choose to include the put-call ratio in our robustness check as an alternative measure of sentiment.

Instead of attempting to capture sentiment with market-based variables, previous research has offered a range of different alternatives. As an alternative, some practitioners have been in favour of survey-based indices. Brown and Cliff (2005) use a direct survey measure based on data from Investor's Intelligence, which captures the number of market newsletters that are labelled either bullish, bearish or neutral. Similarly, Lemmon and Portniaguina (2006) explore the time-series relationship between investor sentiment and the small stock-premium using consumer confidence as a measure of market optimism. Qiu and Welch (2004) compares investor sentiment measures based on consumer confidence surveys with measures extracted from the closed-end fund discount, demonstrating that these are relatively uncorrelated. Measuring consumer confidence by the UBS/Gallup Index for Investor Optimism, the authors show that only this measure correlates well with sentiment.

Some empiricists are in favour of retail investor trades as a sentiment measure. Greenwood and Nagel (2009) show that relatively younger traders were more prone to a larger extent buy stocks at the optimum of the Internet bubble. Similarly, Barber et al. (2009) and Kumar and Lee (2006) investigate trading data to find that retail actors pursue buy and sell decisions in agreement. Option implied volatility is also a conventional way of measuring sentiment (BW, 2007). The market volatility index, hereafter VIX, measures the implied

volatility of options on the S&P 500 stock index. We include VIX as a control variable in our regression specifications. Last but not least, insider trading has been suggested in the literature. Intuitively, executives may have superior information about the true value compared to external investors. Seyhun (2000) brings forth evidence of the possibility of interpreting insider trading activity to predict returns.

Barberis et al. (1998) develop a unique model of investor sentiment picturing one bayesian investor and one asset, with predictions consistent with empirical data findings. Feldman (2010) also constructs a unique index, a loss index, being able to predict returns, especially for one and two-year horizons.

Da et al. (2014) brings forth an alternative measure of sentiment by constructing a Financial and Economic Attitudes Revealed by Search index, hereafter referred to as FEARS. The authors advocate the usage of a direct measure by tracking Internet search behaviour by aggregating the volume of search activity for words using the Google Trends, a software application. Specifically, the relative amount of a range of different search terms associated with economic pessimism is used as investor sentiment proxies. The sentiment index we construct in this study in the desire of relating it to corporate bond yield spreads relies on the proposed methodology by Da et al. (2014).

2.3 Documentations in Equity Markets

This subsection aims to describe empirical documentations on sentiment related to equity markets. Previous findings in the stock market proves to shed light on how sentiment affects bonds. Equity and debt both represent joint positive delta claims on the same assets (Merton, 1974) and share common risk factors (Fama and French, 1993). Therefore, it is of economic interest to briefly discuss prior research as it might improve the understanding of anticipated effects of sentiment on bond yield spreads and highlight potential implications.

BW (2006) studies how investor sentiment affects the cross-section of stock returns. The authors believe that systematic mispricing arises because of both an uninformed demand shock and limits to arbitrage. Therefore, investor sentiment is likely to affect asset prices through two separate channels: Either sentimental demand shocks vary cross-sectionally, while arbitrage limits are constant. Alternatively, the difficulty to arbitrage varies but sentiment is constant. In line with this, the authors predict that investor sentiment has larger effects on assets whose valuations are highly subjective and difficult to arbitrage. They find that when beginning-of-period proxies for sentiments are low, subsequent returns are relatively high, especially for small, young, high volatility, unprofitable, non-dividend paying, distressed and extreme growth

stocks. The authors show that these results remain inconsistent with the traditional explanation that these results are due to compensation for systematic risks.

Perhaps the first documentation on investor sentiment is thanks to Niederhoffer (1971), investigating and documenting a short-term relationship between world events and stock prices. Similarly, Tetlock (2007) measures the interactions between media and the stock market using information on a daily basis from a well-known newspaper column, finding that high media pessimism forecasts decreasing prices and subsequent reversals due to systematic price correction. Additionally, Livnat and Petrovits (2009) show that holding very good news firms after pessimistic sentiment periods earn significantly higher abnormal returns than considering the contrarian scenario, namely holding extreme good news firms following optimistic sentiment periods. Neal and Wheatley (1998) uses data from 1933 to 1993 and studies the forecast power of closed-end funds, the ratio of odd-lot sales to purchases and net mutual fund redemptions on returns. The author's findings are mixed; fund discounts and net redemptions have forecasting power about the size premium, whereas there is only little support for the odd-lot ratio in forecasting returns. Also, other authors able to identify sentiment related findings in explaining the time series return relationships include Shiller (1981, 2000), Kothari and Shanken (1997). Lee et al. (1991) claim with their findings that discounts and premium patterns on closed-end funds are driven by investor sentiment changes.

Da et al. (2014) show that their Financial and Economic Attitudes Revealed by Search index predict short-term return reversals in the stock market consistent with theoretical sentiment predictions brought forward in BW (2006). Also, the authors find that their proxy of investor sentiment reveals patterns of mutual fund flows out of equity funds into bond funds in addition to temporary volatility fluctuations.

2.4 Documentations in Debt Markets

Even though investor sentiment is likely to have pervasive influence on a wide array of assets, the amount of research regarding sentiment in debt markets is relatively scarce.

Laborda and Olmo (2014) studies the relationship of the sentiment based on the market-variables proposed by BW (2006) to predict abnormal returns on US government bonds and demonstrates the presence of an investor sentiment factor, with characteristics similar to the single-return forecasting factor based on the information embedded in the yield curve. Thus they find that the market-variables making up the index can be reduced to a single sentiment pricing factor and that this factor has predictive power beyond other benchmark factors. Aristei and Martelli (2014) also investigate the impact of behavioural factors on sovereign bond yield

spreads in the Euro area using data from 2000-2012, however, founding the analysis on a heterogeneous dynamic panel data approach. The authors show that behavioural factors add information on yield spreads and that sentiment contributes to widen spreads during recessionary economic periods.

Huang et al. (2015) explores the relationship between investor sentiment, as measured by BW (2006), and corporate bond yield spreads based on transactional bond data. More in detail, the paper investigates whether the effect of stock market sentiment bears explanatory power for corporate bond yield spreads and whether such a spill-over effect is stronger when considered in relation to the recent financial crisis. Sentiment is found to be negatively related to corporate bond yield spreads contemporaneously, consistent with the prediction that investors during periods of high sentiment tend to overprice corporate bonds and vice versa. They conclude that equity market sentiment forecasts the cross-section of corporate bond yield spreads and that these results remain robust even after including default risk, bond liquidity and macroeconomic variables. They also provide evidence that stock market sentiment is a state variable driving the pricing of other assets, i.e. bonds.

While Huang et al. (2015) puts more weight on the joint properties and integration of equity and debt markets in relation to sentiment, Nayak (2010) puts more emphasis on solely investor sentiment, also by using the BW index, related to corporate bond yield spreads. The authors find that spreads co-vary with sentiment and that mispricings and reversals very well resemble those for stocks as explored in BW (2006). More specifically, bonds are underpriced - with high yields - during pessimism and they are overpriced - with low yields - when optimism prevails in the market. Reversal patterns result in predictable positive relation trends in post-sentiment yield spreads as a result of delayed price correction: When beginning-of-period of sentiment is high, subsequent yield spreads are high and vice versa. Consistent with BW, bonds whose valuations are highly subjective and difficult to arbitrage, demonstrate greater sensitivity to mispricings due to sentiment. In particular, the empirical results show that it holds for high yield issues, low ratings, extreme maturities, low durations and bonds with distressed attributes. Both papers have in common that they investigate sentiment effects on bond yield spreads over longer horizons.

Drawing from evidence suggested in these papers, we uniquely contribute to the literature by examining whether investor sentiment affects corporate bond yield spreads over shorter-time horizons. To our knowledge, we are also the first to consider this relationship through the lense of a search-based investor sentiment measure.

3. Data

In this section we describe the data used in our study. Specifically, we demonstrate the established screening criteria in the procedure of obtaining a clean bond sample. Then, we provide information on data for the search-activity and our control variables.

3.1 Corporate Bond Data

The data on corporate bond issues in the U.S are extracted from SDC Platinum, a Thomson Reuters' software application. We use a 10-year sample spanning the time period 2004-2014. SDC platinum includes in depth issue-related information on different bond characteristics. We use Standard & Poor's ratings if these are available. If not so, we use Moody's ratings. We use established screening criteria in the desire of obtaining a clean sample of bond issues. In line with this, issues that are convertible are exempt from the analysis (Huang et al. 2015). We remove callable, redeemable putable, convertible or asset backed issues. Furthermore, we do not include perpetual bonds, variable rate bonds, medium-term notes, rule 144a issues, treasuries, foreign issues, agency bonds and municipals. Moreover, we exclude bonds for which ratings are missing, not reported or not available. To further clean the sample, we exclude issues bearing high (above A+) or low (below C) ratings. Additionally, issues for which yields are missing are excluded. For additional details on sample selection criteria, see (Campbell and Taksler, 2003; Dick-Nielsen, 2009). Our final dataset consists of 6862 observations.

3.2 Data on Search-activity

Our search-based measure builds upon the relative interest for different search queries associated with economic sentiment. The search volume data is extracted from Google Trends and is presented on a weekly basis.[1] When typing a word into the Google Trends application, it returns a search volume index (hereafter SVI) for the search query in question, scaled by its time-series maximum. The day, in which the search activity is the most intense for the search term, is assigned the value of 100. All other data points are given values in proportion to this observation. Thus, SVI does thus represents a relative measure, not an absolute one.

[1] As of 2009, Google accounted for 72.11 % of aggregated search activitity in the US, claimed by Hitwise.

3.3 Other Data

Our controls used within the search-based framework include a high frequency measure of concurrent macroeconomic conditions published by the Federal Reserve Bank of Philadelphia. This measure is called the Auroba-Diebold-Scotti business conditions index, hereafter ADS and is proposed in Auroba et al. (2012). Its underlying seasonally adjusted indicators include weekly initial jobless claims, monthly payroll employment, industrial production, personal income less transfer payments, manufacturing and trade sales as well as quarterly real GDP. An increase in the index indicates above average conditions.

An economic policy uncertainty measure, the EPU, developed by Baker et al. (2015) with the purpose of capturing economic uncertainty related to economic policies is a news-based measure and represents our second control in the specification of our main regression. It is constructed by counting the number of articles from a database, NewsBank Access World News, containing at least one term from three categories of terms with economic connection.

VIX, the market volatility index, is published by the Chicago Boards Options Exchange (CBOE) and is collected from WRDS (Wharton Research Data Base) and measures the implied volatility of options on the S&P 500 stock index. We include VIX as a control variable in the regression specification using the google index. Similarly, the CBOE publishes data on the put-call ratio, which is used for the purpose of demonstrating the robustness of our results.

4. Methodology and Hypothesis Development

This section aims to describe the methodology and the economic intuition underlying the hypotheses. To begin with, the empirical predictions are presented in accordance with the postulated hypotheses. Then, the relevance of the index is briefly demonstrated. Next, the construction process of the search-based measure and the related technicalities are discussed in detail. This is followed by a description of the main test and robustness checks.

4.1 Economic theory and empirical predictions

When market participants are negative about the economy, prevailing pessimism will lead to overestimation of underlying risks and investors will thus underbid bonds resulting in underpriced bonds with yield spreads being higher than values suggested by risk-based fundamentals. The process of delayed price correction for this irrational underpricing - which is triggered by rising sentiment or due to arbitrageurs' rational price exploitation - results in higher subsequent prices or lower spreads. Thus investor pessimism and corporate bond yield spreads are deemed to be positively related contemporaneously, whereas pessimism and

subsequent yield spreads are predicted to be inversely related. Hence, we look for systematic reversal patterns as a result of temporary sentiment induced-mispricings. Accordingly, we postulate and test the following hypothesis:

- Investor sentiment, as measured by internet search activity, is related to yield spreads on U.S corporate bonds. In periods of pessimism, contemporaneous yield spreads are high. After periods of pessimism, subsequent yield spreads are low.

We also think that high yield issues are more sensitive to sentiment and are marked by more erroneous mispricing and more distinct reversal trends. Specifically, during pessimistic regimes, investor demand decreases relatively less for safe low-yield issues compared to speculative high yield bonds. Therefore, we predict that distressed bonds are subject to greater underpricing than low-yield issues. Also, high yield bonds are more prone to subjective valuations and arbitrage constraints and should therefore be more sensitive to mispricing errors, as put forward in BW (2006). In line with this, we also hypothesize:

- The relation between investor pessimism and yield spreads is more pronounced for high-yield bonds.

The hypotheses brought forward are in line with previous research (Nayak, 2010). As opposed to sentiment literature related to equity using returns, our study relates to bond yield spreads instead of bond returns. However, the fact that bond prices are inverse functions of yields make inference analysis identical to equity literature (Nayak, 2010). More concretely, an equity analogy can be made by the implications of our hypothesis: when investors are pessimistic, we hypothesize that subsequent yield spreads are lower for high yield issues in relation to safe bonds, indicating that this bond set earns relatively higher returns.

4.2 Google Trends and the Search Volume Index

Figure 1 plots the relationship for search interest in the word: “Financial crisis” for our sample period (2004-2014). Search activity for this word is clearly aligned with economic intuition as queries increased dramatically in 2008.

This figure shows the search-activity for the word "Financial Crisis" over a ten-year period (2004-2010) obtained from Google Trends.

The search-based measure in Da et al. (2014) is our sentiment measure of choice as it offers several appealing properties as opposed to other established methods. First and foremost, a direct measure with high frequency availability is appropriate given our desire to investigate short-term sentiment effects on yield spreads. Measures based on market variables on the one hand have the benefit of being available at a relatively high frequency, but on the other hand have the shortcoming of being the result of multiple financial forces beyond investor sentiment (Da et al. 2014). Specifically, there is a difficulty in making theoretical input-output predictions with output measures. One of the advantages of a search-based index as opposed to survey-based indices include the high frequency availability of search-based sentiment, which compares to survey-based indices being available only for monthly or quarterly intervals. Additionally, Da et al. (2014) demonstrate that their sentiment index even forecasts monthly survey outcomes of consumer confidence. In line with Da et al. (2014), we advocate the usage of a search-based measure because it uncovers attitudes directly. Singer (2002) show that there is often little incentive to answer surveys carefully, supporting the observation that search volume may potentially reveal more personal information, particularly when there are several respondents missing.

4.3 Search Based Index

As hinted by the previous section, our index relies upon extracting sentiment from pessimism revealing words. The reason for this is that it conforms to text analytics literature. Tetlock (2007) argues that it appears that terms with a negative tone in the English language are most useful in mirroring sentiment. Specifically, Da et al. (2014) follow the General Inquirer's Harvard IV-4 Dictionary and the Lasswell Value Dictionary (Tetlock, 2007; Tetlock et al., 2008) and select words that reveal economic conditions. After passing on several screening criteria, the authors are left with the thirty words that have had the largest negative impact in terms of correlation with equity market returns. We restrict the number of words to thirty as it is commonly viewed that it is the minimum number of observations needed to diversify idiosyncratic noise (Da et al. 2014). Below are the words forming our index listed according to their respective relative importance:

Table 1: Search Terms

	Search Term
1	GOLD PRICES
2	RECESSION
3	GOLD PRICE
4	DEPRESSION
5	GREAT DEPRESSION
6	GOLD
7	ECONOMY
8	PRICE OF GOLD
9	THE DEPRESSION
10	CRISIS
11	FRUGAL
12	GDP
13	CHARITY
14	BANKRUPTCY
15	UNEMPLOYMENT
16	INFLATION RATE
17	BANKRUPT
18	THE GREAT DEPRESSION
19	CAR DONATE
20	CAPITALIZATION
21	EXPENSE
22	DONATION
23	SAVINGS
24	SOCIAL SECURITY CARD
25	THE CRISIS
26	DEFAULT
27	BENEFITS
28	UNEMPLOYED
29	POVERTY
30	SOCIAL SECURITY OFFICE

This table demonstrates the thirty search terms used in the construction of the sentiment index. They are derived from Da et. al. (2014) who obtain the words from the Harvard IV-4 and Laswell dictionaries. The search terms correspond to the words with the largest negative correlation with the equity market, ordered from most negative to least negative.

Even though these words are developed for equity markets, it remains very likely that these are valid for debt markets too. Put differently, it is reasonable that investor sentiment extracted from equity markets has impact on corporate bond yield spreads as well. First and foremost, Huang et al. (2015) provides evidence that stock market sentiment is a state variable driving prices of bonds. Second, there are substantial direct information spillovers between stocks and bonds (Downing et al., 2009; Kwan 1996). Third, bonds and stocks both represent positive delta claims on a firm's asset (Merton, 1974) and share common risk factors (Fama & French, 1993). Also, stock returns and bond returns are well correlated (Collin-Dufresne et al., 2001).

For each search term j, we define the weekly change as:

$$\Delta SVI_{j,t} = \ln(SVI_{j,t}) - \ln(SVI_{j,t-1}) \quad (1)$$

Next, we winsorize each time-series at the 1% level to mitigate the effect of outliers. To adjust for seasonality we develop a seasonality dummy model, in which $\Delta SVI_{j,t}$ is regressed on month dummies. Deterministic seasonality,S_t, can be written as a function of seasonal dummy variables where $s = 12$ for monthly frequencies. Thus we regress $\Delta SVI_{j,t}$ on an intercept and monthly dummy variables$D_{i,t}$, omitting one season (January) and keep the residuals:

$$\Delta SVI_{j,t} = \propto + \sum_{i=1}^{s-1} \beta_i \, D_{i,t} + \varepsilon \quad (2)$$

Also, to make each-time series comparable, each time series is standardized by scaling with the time-series standard deviation. Finally, we have our adjusted, e.g winsorized, deasasonalized and standardized weekly SVI, $\Delta ASVI_j$, for each of the thirty search terms. Having the adjusted SVI for each word, we proceed with forming the search-based index, being equally weighted for the thirty search terms:

$$SentIndex_t = \frac{\sum_{j=1}^{j=n} \left(\Delta ASVI_{j,t}\right)}{n} \quad (3)$$

4.4 Bond Yield Spreads

The yield spreads of corporate bonds constitute the dependent variable of our main tests. We define the yield spread for a specific bond i as:

$$YieldSpread_i = YieldtoMaturity_i - TreasuryRate \quad (4)$$

Where $TreasuryRate$ is the corresponding treasury yield.

Next, we form various sub-samples based on different bond characteristics. Specifically, we categorize our bond sample according to industry, namely whether firms are financial or nonfinancial as indicated by the SIC-code. Also, bond issues are grouped according to their respective ratings and maturities. This classification is necessary as we expect to detect larger effects of sentiment on speculative, high-yield issues.

Each corporate bond issue in a given week t within a specific sub-sample as defined above is included in forming weekly average yield spreads:

$$AverageWeeklyYieldSpread_t = \frac{\sum_{i=1}^{n} YieldSpread_{i,t}}{n} \quad (5)$$

4.5 Main Regression

The test includes identifying yield spread reversals by running the following regression on the search-based index contemporaneously as well as up to four weekly yield spread leads:

$$YieldSpread_{t+k} = \alpha + \beta * SentIndex_t + \sum_n \gamma_n ControlVariable_t^n + \varepsilon_{t+k} \quad (6)$$

Where $YieldSpread_{t+k}$ corresponds to the average weekly yield spread within a specific sub-sample as defined in equation (5) for different leads. As aforementioned, the control variables include the volatility index (VIX), changes in the economic policy uncertainty (EPU) measure as well as changes in the Auroba-Diebold-Scotti Index (ADS Index). We also include a one week lag of the yield spread as a control variable. This regression is conducted for each and every sub-sample as previously defined.

4.6 Robustness Tests

In this section we describe the tests to evaluate the robustness of our findings. This analysis represents an essential part of our analysis regarding the ability of our index to capture investor sentiment as well as the validity of our findings over different-time horizons and sub-periods.

4.6.1 Sub-period and Time-horizon Robustness

Our empirical results are dependent upon predictable spread patterns following sentiment-driven mispricings when these are corrected on a weekly basis. Perhaps are such corrections unlikely to occur in a week. Previous documented results between investor sentiment and corporate bond yield spreads are mainly focused on identifying reversals on longer horizons. On the other hand, to investigate whether such reversals can be readily observed on a daily basis for corporate bonds, similar to what Da et al. (2014) finds in the stock market, we re-index our weekly google data into a daily frequency. In addition to investigating whether our findings remain robust to alternative specifications of different time lags in identifying yield spread reversals, we consider different sub-periods within our ten-year sample period (2004-2014). We do this by splitting the sample into a pre-onset subsample and a post-onset subsample of the financial crisis, the former being 2004-2007 and the latter being 2007-2010. This specification is motivated by the assertion that corporate bonds and stocks were riskier after the initiation of the financial crisis, making it more probable that stock market sentiment more strongly influences the corporate bond market level of sentiment. Additionally, the crisis may have rendered increased arbitrage activity with regard to firm capital structure becoming more attractive, potentially engaging more investors to such a strategy. As a result, bond markets are more related to equity sentiment after the onset of the crisis (Huang et al. 2015).

4.6.2 Re-specification of the Search-based Index

Another crucial question pertaining to the construction of the index regards the ability of it to correctly capture sentiment with the target being the majority of investors in the U.S corporate bond market, in particular institutional investors (Campbell and Taksler, 2003). Since the inclusion of all specific words forming our index might be controversial and open to debate as to whether they optimally reflect biased investor outlooks of these market participants, we exclude a range of words that intuitively might be related to the beliefs of retail investors as opposed to institutional investors. As an additional measure, we add words that may be more attributable to the institutional investors predominating the bond market. The inclusion and exclusion of words is based on terms from text analytics literature, specifically the Harvard IV-

4 Dictionary and the Laswell Value Dictionary. We exclude the words in column 1 and add words in column 2, as indicated by Table 2. The words are listed below:

Table 2: Words added and excluded to the sentiment index

Words Excluded	Words Added
SOCIAL SECURITY CARD	FILING BANKRUPTCY
SOCIAL SECURITY OFFICE	BANKRUPTCY COURT
CAR DONATE	CHAPTER 7
DONATION	DEBT COLLECTION
CHARITY	NATIONAL DEBT
BENEFITS	INFLATION

In addition to this, one might raise the concern that some of the words are relatively more important in revealing sentiment than others. Consequently, we re-specify our index by assigning weights to the different search terms in order to check whether our empirical results conform to our main findings[2]. The weights are based on the relative importance of each search term's correlation with stock returns as obtained by Da et al. (2014). This procedure is carried out for the original list of search terms.

4.6.3 Choice of Sentiment Measure

Separately, we repeat our tests using a market variable sentiment indicator, namely the put-call ratio to test the robustness of our findings to an alternate measure of sentiment. We regress yield spreads on the put-call ratio to potentially observe whether this variable have forecasting power beyond that contained in our sentiment index. This indicator is widely regarded as an indicator of pessimism, and its relationship with yield spreads conforms to the established hypothesis. Thus, we expect this variables to enter with the same signs in our regression outcomes as for our index. Specifically, we estimate:

$$YieldSpread_{t+k} = \alpha + \beta * \Delta PutCallRatio_t + \sum_n \gamma_n ControlVariable_t^n + \varepsilon_{t+k} \qquad (7)$$

[2] The weights are based on the words' respective t-statistic obtained by Da et al. (2014) when regressing the words on market returns.

5 Empirical Results

In this section, the empirical findings are presented and analyzed. First, the obtained descriptive statistics with regard to both the full sample and different categorization criteria are discussed. Next, a presentation of the regression outputs accompanied by an analysis with respect to the different sub-samples. Finally, we validate and evaluate the robustness of our findings with different measures.

5.1 Descriptive Statistics

This section presents the descriptive statistics, including tabulated summary statistics for a range of different sub-samples as well as basic correlation analysis.

5.1.2 Summary Statistics

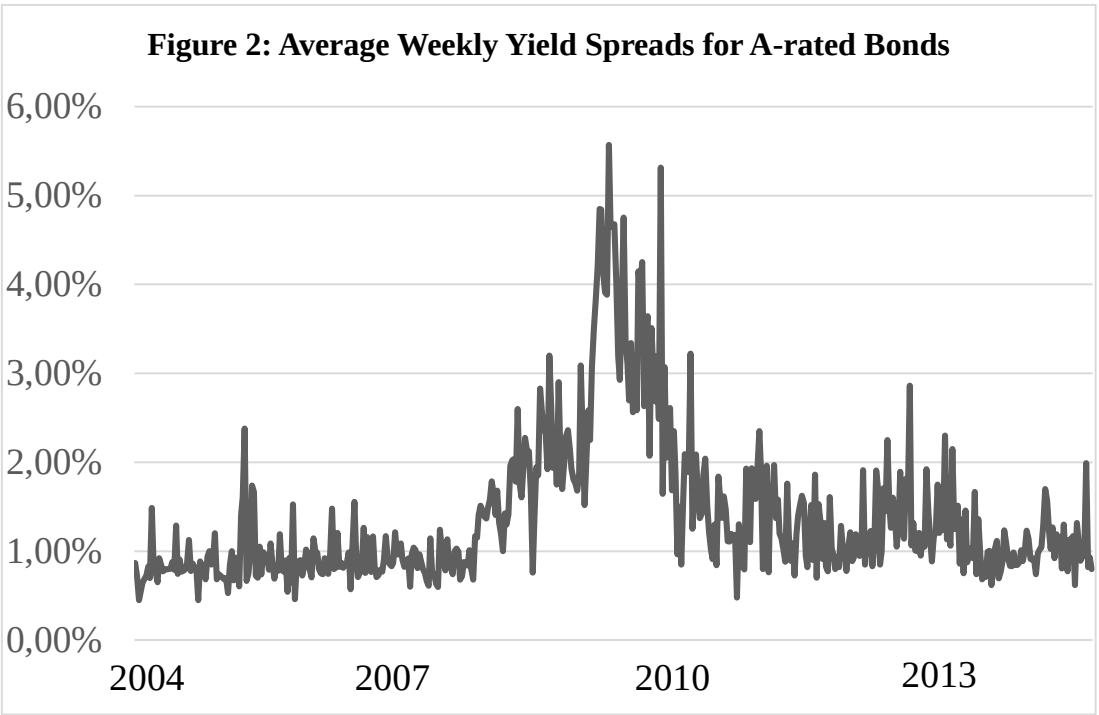
Table 3. Summary statistics of bond sample 2004-2014

	Number of observations	Mean Spread	Median Spread
All bonds	6862	2,46	1,73
Industry			
Financial	2057	1,95	1,45
Nonfinancial	4805	2,68	1,85
Rating			
A	2637	1,37	1,05
BBB	2583	2,09	1,7
BB or less	1642	4,81	4,35
Maturity			
Short-term	3133	2,91	1,9
Long-term	3729	2,09	1,65
Rating & Maturity			
A, short maturity	1198	1,29	0,88
A, long maturity	1439	1,44	1.16
BBB, short maturity	915	2,18	1,6
BBB , long maturity	1668	2,04	1,7
BB or less, short maturity	1020	5,48	5,04
BB or less, long maturity	622	3,72	3,43

This table reports the number of observed bond issues over the sample period as well as the average and median yield spread in percentages for different categories of bonds on the basis of rating, maturity and whether issuing firms are financial or non-financial as indicated by their main SIC-code. Short- and long-term bonds have maturities of 1-10 years old and >10 years, respectively. The A-category includes issues bearing A+, A or A- ratings. The BBB-category includes issues bearing BBB+, BBB or BBB- ratings. The BB-category includes issues bearing BB+ or lower (junk bonds).

Table 3 presents the summary statistics for different bond categories. The sample in its entirety covers 6862 observations with an average spread 2.46 % and a median spread of 1.73 %. For each and every sub-sample, the median spread is lower than the average spread which embodies the fact that the median is more insensitive and not affected by outliers. Financials exhibit lower spreads (roughly 70 bp) than nonfinancial firms, with the categorization being based on SIC-codes. The pre-onset period of the financial crisis is characterized by significantly lower spreads compared to the post onset period of the financial crisis, which proves valuable in conducting our robustness evaluation. Figure 2 displays the time trend of bond yield spreads for A-categories and verify this observation. A very apparent, yet intuitive, relationship between ratings and yield spreads prevails; relatively higher ratings indicate relatively lower spreads and vice versa. The magnitude of the difference is largest between the BBB and the less than BB sub-categories, which is reasonable since the latter group covers a wider array of relatively lower rated issues. Unexpectedly, long-term bonds exhibit higher spreads than either short- or long-term bonds, especially the latter. This could possibly be due to the pre-set cut-off level with regard to maturity. Therefore, we account for ratings as well; for high rated bonds, spreads are higher for longer maturity and vice versa.

Figure 2: Average Weekly Yield Spreads for A-rated Bonds



This figure shows the average weekly yield spreads over the sample period (2004-2014) for the A-rated category (A+, A or A-).

5.1.3 Correlation

As a general exercise, basic correlation analysis of both contemporaneous, leading bond yield spreads and sentiment for our junk-bond category (BB or less rated bonds) is displayed in Appendix table A.5.

Given our hypothesis, the correlation of contemporaneous yield spreads and current pessimism should expectedly be marked by positive values, while the expected correlation on a leading basis should exhibit the reverse. It seems that the opposite is the case at hand initially, yet the correlation does not exhibit either statistical or economic significance. These preliminary results do not lend initial support to the postulated hypothesis. Similar results are valid for the rest of the sub-samples as well.

5.2 Main Results

The correlation matrix hints that there is no obviously pronounced relationship between sentiment and yield spreads. Having intuitively reasoned about anticipated economic effects, we know turn to investigating the relationship between sentiment and yield spreads by running our main regression (equation number 6).

As aforementioned, a key prediction of investor sentiment theories is reversal. This phenomenon reflects a sentiment induced mispricing due to emotional biases giving rise to uninformed demand shocks which, in the presence arbitrage constraints, cause prices to temporarily deviate from fundamental values. Accordingly, we hypothesize that in periods of increased pessimism, contemporaneous yield spreads are high. Following periods of pessimism, subsequent yield spreads are low. In order to find evidence of reversals, we look for systematic sentiment-driven mispricings and subsequent mispricing corrections. Translating this into statistical terms, we wish to detect positive coefficients of our index contemporaneously, implying that prevailing market pessimism causes overestimation of underlying risks, resulting in higher yield spreads. When regressing our index on leading yield spreads, we wish to extract negative coefficients of our index variable, embodying delayed price correction. Also, in line with the postulated hypothesis, the coefficients should bear higher values in order to account for the prediction that relatively higher-yield issues are characterized by higher sensitivity to investor sentiment. All empirical results posted in this have robust standard errors.

Table 5 reports the regression outputs for the A category, including A+, A and A- bonds. The coefficient of the sentiment index for the contemporaneous yield spread is marked by a positive sign, which conforms to economic intuition. This is followed by a negative coefficient

for the one-week lead yield spread, which indicates a reversal pattern. However, both coefficients remain statistically insignificant. Additionally, the standard errors are larger than the values of the coefficients, further strengthening the notion that sentiment and yield spreads might not be related in line with our predictions. Thus, these results cannot not be given any relevance. Similarly, the coefficients of the two and three week lagged yield spreads remain statistically as well as economically insignificant. The four week lead yield spread is negative but cannot be given any economic importance when considering this jointly with other leads. Taken together, the irregularities and insignificance among the coefficients cannot support our initial hypothesis.

Table 5: Regression outputs for A-rated bonds

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	0.00608	-0.00834	0.0257	0.0616	-0.0272
	(0.0339)	(0.0296)	(0.0371)	(0.0463)	(0.0517)
ADS	-0.0266	0.0355	0.0568	0.0312	-0.0739
	(0.214)	(0.199)	(0.227)	(0.300)	(0.337)
EPU	0.000213	-0.000301	-0.000144	-0.000673	0.000747
	(0.000548)	(0.000661)	(0.000621)	(0.000738)	(0.000754)
VIX	0.0380***	0.0396***	0.0444***	0.0429***	0.0401***
	(0.00504)	(0.00450)	(0.00464)	(0.00444)	(0.00455)
YS_{t-1}	0.460***	0.440***	0.368***	0.375***	0.398***
	(0.0647)	(0.0502)	(0.0541)	(0.0585)	(0.0598)
Constant	-0.0203	-0.0249	-0.0226	0.00228	0.0280
	(0.0466)	(0.0485)	(0.0514)	(0.0522)	(0.0543)
Observations	513	512	511	510	509
R-squared	0.726	0.725	0.705	0.688	0.669

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of the regression relating weekly average yield spreads for bonds rated A (A+, A or A-) to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3), (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table 6 reports the regression coefficients for the category with second highest ratings, the BBB sub-sample, including BBB+, BBB and BBB- bonds. Unexpectedly, the contemporaneous coefficient of the index enters with a negative sign in conflict with economic intuition: Increasing pessimism indicates underestimation of risks, with lower yield spreads than normal rather than the opposite. This is followed by a positive sign for the first-week lead yield spread, which similarly, has no underlying economic support. Put differently, this reversal-pattern indicates no systematic price correction. These results are furthermore statistically insignificant. Subsequent two-week, three-week and one-month lead yield spreads represent non-systematic irregularities and are insignificant both from an economical and statistical point of view. However, the majority of the coefficients except for the two-week and three-week yield spread leads are relatively larger compared to those for the A category, demonstrating only vague indications that relatively higher-yield issues are more susceptible to changing sentiment (regardless of the signs of the coefficients). Additionally, as there is no statistical significance supporting this claim, such a claim would be nothing but highly controversial and questionable.

Table 6: Regression outputs for BBB-rated bonds

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.0423	0.0103	0.00235	-0.00686	-0.0841
	(0.0753)	(0.0501)	(0.0403)	(0.0466)	(0.0688)
ADS	0.0976	0.0945	0.106	0.00122	0.149
	(0.285)	(0.274)	(0.284)	(0.300)	(0.331)
EPU	-0.000425	0.000623	-0.000213	0.00150**	3.46e-05
	(0.000779)	(0.000917)	(0.000847)	(0.000754)	(0.000889)
VIX	0.0506***	0.0600***	0.0616***	0.0599***	0.0708***
	(0.00595)	(0.00690)	(0.00586)	(0.00549)	(0.00633)
YS_{t-1}	0.463***	0.391***	0.385***	0.399***	0.292***
	(0.0534)	(0.0602)	(0.0503)	(0.0521)	(0.0476)
Constant	0.107	0.0728	0.0557	0.0510	0.0616
	(0.0713)	(0.0707)	(0.0656)	(0.0634)	(0.0764)
Observations	507	507	507	505	504
R-squared	0.705	0.715	0.726	0.752	0.713

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for bonds rated BBB (BBB+, BBB or BBB-) to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3), (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Turning to the last category of investigation, shown in Table 7, namely the BB or less group (junk bonds), we find once again that the results are generally statistically insignificant and inconsistent with theoretical economic predictions. Even though that the three-week lead yield spread enters with a sign being significant at the 10 % level, there is no meaningful economic interpretation, especially considering it jointly with the other coefficients. The negative contemporaneous sentiment-yield-spread-relationship remains and the subsequent findings persist with positive signs. Similar to above, the BB category demonstrates the largest susceptibility to investor sentiment in relation to all the categories being under consideration in the rankings-based sample (regardless of the coefficient signs). However, one should not rely on these findings as there is no statistical significance justifying the results. Therefore, they remain dubious. Similar to other sub-samples, the standard errors are generally larger than the values of the coefficients.

Table 7: Regression outputs for junk (BB-rated) bonds

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.0837	0.0463	0.0154	0.257*	0.210
	(0.114)	(0.117)	(0.122)	(0.136)	(0.148)
ADS	-0.450	-0.173	-0.185	-0.136	-0.176
	(0.732)	(0.778)	(0.732)	(0.732)	(0.790)
EPU	-0.000228	0.000884	0.000565	4.21e-05	0.00169
	(0.00184)	(0.00194)	(0.00184)	(0.00195)	(0.00196)
VIX	0.0984***	0.118***	0.122***	0.126***	0.124***
	(0.0104)	(0.0105)	(0.0111)	(0.0110)	(0.0119)
YS_{t-1}	0.349***	0.205***	0.186***	0.136***	0.170***
	(0.0489)	(0.0517)	(0.0508)	(0.0516)	(0.0527)
Constant	1.401***	1.743***	1.757***	1.927***	1.801***
	(0.187)	(0.183)	(0.195)	(0.207)	(0.193)
Observations	508	507	506	505	504
R-squared	0.538	0.503	0.492	0.477	0.482

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for junk bonds (bonds rated BB+ or lower) to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3) (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

To explore the consistency of these results, the same regression is conducted for other bond characteristics than rating. The regression is repeated for bonds with maturities longer than 10 years (Appendix table A.1) and for bonds with maturities shorter than 10 years (Appendix table A.2), consistent with the categorization of long-term and short-term bonds. Similarly, the regression is conducted on an industry basis (Appendix table A.3 and A.4). With regard to economic and statistical significance, the results are generally similar and do not support any systematic reversal-patterns being the outcome of sentimental demand shocks and correction of erroneous mispricings.

To summarize, we find no evidence of sentiment-driven mispricings giving rise to systematic reversals, neither statistically nor economically. The relationship between investor sentiment, as measured by search activity, and corporate bond yield-spreads appears to be weak as revealed by our tests, at least on a weekly basis.

5.3 Robustness Evaluation

In this subsection, the robustness of our findings are demonstrated. Specifically, we attempt to display the robustness of our results according to different sub-periods, time horizons as well as re-specifications of our index in terms of reweighting the impact of certain words within the index and removing (adding) potential search queries associated with retail (institutional) investor sentiment.

5.3.1 Sub-period and Time Horizon Robustness

Because there is reason to believe that the effect of sentiment may be different under specifications of different sub-periods as mentioned previously, we divide our sample into a pre-onset and post-onset period of the financial crisis, namely 2004-2007 and 2007-2010, respectively. Appendix table B.1 shows the regression output for the regression outlined in previous sections based on these specifications for our BB (junk bond) category for the pre-onset period.

There is still no evidence of systematic sentiment-induced reversals. Regardless of the 5% significance level of contemporaneous yield spreads, little relevance can be attributed to such a result as it conflicts with economic intuition: Contemporaneous returns are still negatively related to investor sentiment. Considering subsequent yield spread leads, these are mostly marked by positive values with neither economical nor statistical significance, except for the third lead which does not alter the total interpretation. Hence, no support can be given

to systematic sentiment-induced reversals. Generally, this applies to each and every sub-category of ratings.

Appendix table B.2 shows the obtained regression outputs for the post-onset period, which should be marked by larger values of coefficients and stronger trends during the crisis to account for potentially increased sentiment susceptibility as outlined in previous sections. The majority of the coefficients are indeed larger, but no interpretational importance can be attributed to these findings as none of them appear statistically or economically insignificant. All in all, our results remain robust to alternate specifications of sub-periods.

Next, we consider the presence of systematic reversals due to sentiment-induced mispricing on an even shorter horizon, i.e. on a daily frequency. As similar to the sub-period categorization, we find no results of reversal trends. However, given that we only consider issuance data that renders relative scarcity of observations, it is virtually impossible to relate yield spreads on a daily horizon to investor sentiment. Consequently, no absolute conclusion can be drawn regarding the absence of systematic reversals on a daily basis. The outputs from this robustness check is not included due to its very limited relevance.

5.3.2 Re-specification of the Search-based Index

Because our sentiment relies upon the identification of sentiment revealing terms, we re-weight the impact of different words to test for the robustness of our findings. Appendix table B.3 displays the regression outputs based on a different weighting schedule, namely according to the magnitude of the relative importance of each search term (rather than equal weights), based on the BB-rated category.

Also with regard to the re-weighting schedule, our findings remain robust. The results resemble the obtained results in our main tests in some considerations; generally, the estimates are somewhat lower under the alternative weighting schedule and the third-week leading yield spread is significant at the 10 % level. While it is statistically significant to some extent, economic intuition does not support, nor allows any meaningful interpretation of the coefficient. For other leads, the results are both economically and statistically insignificant. This holds for the rest of our different categories as well.

It is not only essential that our index reveals sentiment, but also captures sentiment first and foremost of the investors predominating the bond market. As a result, we remove potential words that are likely to be relatively uncorrelated with institutional sentiment and add search queries that intuitively would correlate well with institutional sentiment. Appendix table B.4 shows the BB-category under this re-specification. Our results remain robust and similar to

those obtained previously, with the results being valid for different rating categories as well as other categories.

5.5.3 Choice of Sentiment Measure

Appendix table B.5 displays the regression outputs obtained when the put-call ratio is the underlying sentiment indicator for the junk bond (BB or less) sub-sample. The coefficients are positive with no exception indicating that increased pessimism renders higher yield spreads, consistent with overestimation of underlying risks. However, these results are statistically insignificant. Furthermore, there is no indication of systematic mispricing. Thus, our results appear similar to this alternate measure of sentiment in interpretational terms. This holds for the rest of the sub-samples as well.

6 Discussion

In this section an attempt to discuss the implications of our results is made. First, the results are discussed in relation to other asset classes and the assumptions underlying the hypotheses. Then, we proceed with a discussion of the limitations inherent in the study.

6.1 The rate of sentiment incorporation

Previous research has found evidence of sentiment-induced mispricings in corporate bond markets. Systematic patterns of erroneous pricing have been documented on both a monthly (Huang et al., 2015) as well as on an annual and semiannual basis (Nayak, 2010), with both having in common the usage of a market variable based index as suggested by BW. This study attempts to explore the prediction of reversals on a shorter horizon, namely on a weekly basis, using a search-based approach of measuring sentiment. As demonstrated by the empirical tests, we find no evidence of such reversals.

To explore whether systematic mispricing errors might occur on an even shorter time horizon, we test whether sentiment impacts corporate bond yield spreads on a daily basis, with the results still not revealing any reversals. However, due to the lack of a sufficient amount of observations on a daily frequency, the possibility of reversals occurring on an even shorter horizon cannot be fully dismissed. However, equity literature has manifested analogous reversals over both short and long-term horizons (see previous literature).

Given that the sentiment index satisfactorily reflects institutional investor sentiment and that there are no reversals occurring on either a weekly or daily time-horizon, these results might possibly shed some light on the rate of which corporate bonds are likely to incorporate

sentiment in relation to stocks. Direct information-spillovers between debt and equity markets have been demonstrated. Downing et al. (2009) explore the relative informational efficiency of stocks and bonds demonstrating that stock returns lead bond returns for non-convertible junk- and BBB-rated bonds, and that stock returns lead bond returns for convertible bonds in all rating classes. The authors claim that these results indicate that the corporate bond market is less informationally efficient than the stock market. In an influential paper, Kwan (1996) shows that stocks lead non-convertible bond returns even for bonds which are solidly investment grade and most importantly, that stocks leads bond in reflecting information. Additionally, this might be consistent with the observation that corporate bonds are traded more infrequently and depict considerably limited liquidity (Campbell and Taksler, 2003; Bao et al., 2011). Drawing from these findings, our results could potentially indicate that bonds incorporate sentiment at a relatively slower rate compared to equity markets. Once again, we want to emphasize that this eventuality is strongly conditional on non-occurring reversal trends on a shorter horizon. Apart from this, such an observation relies on the assumption that the index adequately captures the appropriate sentiment. This issue is discussed below.

6.2 The Precision of the Sentiment index to capture Institutional sentiment

Implicit is the assumption that the sentiment index captures the appropriate sentiment. By nature, a search-based sentiment approach is more aligned towards capturing the sentiment of retail investors, which have pervasive influence in equity markets (Da et al., 2014). More specifically, search-behavior can perhaps be claimed to not capture sentiment accurately in terms of not including the correct key players, i.e. institutional investors.

However, there is reason to believe that there is a strong linkage, at least indirectly, between search activity and institutional investor sentiment due to broad information spill-overs, market integration and intra-effects of sentiment. A number of papers has tested and confirmed the hypothesis that individual investors are net buyers of attention-grabbing stocks, e.g. stocks appearing in news (Barber and Odean, 2008). This hints that individual investors mimic institutional investor behaviour that might give rise to media attraction and that individual investor demand to some degree might reflect the beliefs prevailing among institutional investors. Also both individual and professional investors have been claimed to behave in a similar fashion with regard to different types of assets, such as company stock options (Heath et al, 1999), real estate (Genesove and Mayer, 2001) and futures (Locke and Mann 2000; Heisler 1994). Taken together, it remains likely that our index pictures and reflects institutional investor sentiment satisfactorily, particularly with consideration to our robustness

tests yielding similar results to those obtained previously when reweighting and adding/removing words intuitively being linked to institutional/retail sentiment.

6.3 Other Limitations

Additionally, we would like to notify the reader of several limitations to be aware of. First, corporate bonds trade infrequently and inter-trade gaps are often large (Nayak, 2010), making a short-term sentiment approach more difficult to adopt for corporate bonds. Second, we consider data on bond issues in our analysis and not transactional data, for which we are not granted any access. This might affect the reliability of our test to some extent in general.

7. Conclusion

This study sets out to examine whether investor sentiment, as measured by search-based activity, helps to explain yield spreads on U.S corporate bonds. Building on previous findings having detected systematic reversals as an outcome of sentiment-induced mispricing, we attempt to extend these results by considering shorter time horizon and adopting a non-conventional measure of sentiment. Specifically, our study addresses two questions: Do biased investor outlooks affect yield spreads? Are such effects stronger and more pronounced for speculative high-yield issues?

As suggested by our empirical findings, no evidence of systematic reversal patterns is found. The findings are generally both economically and statistically insignificant, providing no support for our initial hypotheses. In particular, there is no support that increasing contemporaneous pessimism gives rise to overestimation of underlying risks rendering higher yield spreads than indicated by fundamental values. In subsequent time periods, there is no evidence of delayed price correction due to changing sentiment or rational price exploitation by arbitrageurs. These results remain the same for sub-samples based on ratings, maturity and industry. These results remain robust to a range of different re-specifications with regard to the sentiment index, sub-periods, time-horizons and an alternate measure of sentiment.

Given that the composite index measure satisfactorily reflects sentiment and that there are no deviations from fundamental values giving rise to systematic reversals on weekly and daily timescales, our results might indicate that bonds incorporate sentiment at a slower rate than stocks, for which such results have been found. This is consistent with previous documentations on direct spillovers between debt and equity markets with stocks leading bonds in the reflection of information, that bonds depict considerably limited liquidity and that these markets are well integrated.

Since bonds trade infrequently and trade gaps are often large, the usage of bond issuance data instead of including transactional data depicts a limitation of our study. It would indeed be interesting and valuable if future research aimed at complementing our findings by further investigating the short-term relationship between sentiment and corporate bond yield spreads, both by adopting alternate indicators of sentiment and including transactional data as this would be ideal.

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A Appendix: Main Results

Table A.1: Regression outputs for maturities above 10 years.

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.212**	0.00540	0.119*	-0.0472	-0.0852
	(0.0875)	(0.0606)	(0.0684)	(0.0815)	(0.0966)
ADS	0.452	0.567	0.608	0.535	0.577*
	(0.591)	(0.503)	(0.407)	(0.404)	(0.338)
EPU	-3.82e-05	0.000192	-2.89e-05	0.00128	-0.000179
	(0.00102)	(0.00106)	(0.00110)	(0.00121)	(0.000929)
VIX	0.0508***	0.0570***	0.0572***	0.0522***	0.0578***
	(0.00555)	(0.00581)	(0.00559)	(0.00697)	(0.00543)
YS_{t-1}	0.224***	0.175***	0.165***	0.222***	0.159***
	(0.0531)	(0.0422)	(0.0421)	(0.0804)	(0.0361)
Constant	0.704***	0.696***	0.711***	0.662***	0.691***
	(0.0900)	(0.0897)	(0.0869)	(0.115)	(0.0923)
Observations	488	487	487	487	485
R-squared	0.406	0.396	0.404	0.428	0.433

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for bonds with maturities longer than 10 years to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3), (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table A.2: Regression outputs for maturities below 10 years.

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.225**	0.0689	-0.0327	0.143	-0.00353
	(0.105)	(0.109)	(0.118)	(0.121)	(0.117)
ADS	0.342	-0.0122	-0.300	-0.400	-0.421
	(0.604)	(0.637)	(0.659)	(0.637)	(0.587)
EPU	0.000174	0.000814	-0.00141	0.000584	0.000353
	(0.00146)	(0.00151)	(0.00155)	(0.00162)	(0.00152)
VIX	0.0606***	0.0689***	0.0719***	0.0717***	0.0700***
	(0.00811)	(0.00757)	(0.00801)	(0.00876)	(0.00788)
YS_{t-1}	0.330***	0.253***	0.238***	0.237***	0.228***
	(0.0453)	(0.0486)	(0.0424)	(0.0464)	(0.0419)
Constant	0.772***	0.837***	0.820***	0.817***	0.866***
	(0.162)	(0.158)	(0.152)	(0.155)	(0.146)
Observations	508	507	506	505	504
R-squared	0.386	0.359	0.365	0.371	0.356

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for bonds with maturities of 10 years or less to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3), (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table A.3: Regression outputs for financial firms

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	0.125	-0.0538	-0.0197	-0.0238	0.209*
	(0.0943)	(0.0702)	(0.0888)	(0.0932)	(0.108)
ADS	0.394	0.221	0.870*	1.635***	0.745
	(0.438)	(0.475)	(0.459)	(0.599)	(0.466)
EPU	0.000302	0.000704	-0.00247	0.000278	0.000923
	(0.00125)	(0.00145)	(0.00154)	(0.00143)	(0.00206)
VIX	0.0644***	0.0872***	0.0823***	0.0882***	0.0815***
	(0.0112)	(0.0143)	(0.0115)	(0.0112)	(0.0108)
YS_{t-1}	0.320***	0.253***	0.300***	0.254***	0.244***
	(0.0614)	(0.0529)	(0.0562)	(0.0519)	(0.0477)
Constant	0.178	-0.0748	-0.0884	-0.110	0.0432
	(0.138)	(0.205)	(0.177)	(0.160)	(0.144)
Observations	444	444	441	442	444
R-squared	0.398	0.449	0.471	0.449	0.436

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for bonds issued by financial firms to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3), (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table A.4: Regression outputs for non-financial firms

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.426***	0.0822	0.0923	0.149	-0.190*
	(0.0973)	(0.0917)	(0.0907)	(0.110)	(0.104)
ADS	0.270	-0.00767	-0.328	-0.625	-0.435
	(0.421)	(0.462)	(0.485)	(0.428)	(0.457)
EPU	0.000267	-0.00107	0.00107	0.000362	0.000226
	(0.00123)	(0.00134)	(0.00144)	(0.00127)	(0.00120)
VIX	0.0440***	0.0541***	0.0545***	0.0473***	0.0548***
	(0.00604)	(0.00640)	(0.00647)	(0.00662)	(0.00642)
YS_{t-1}	0.365***	0.233***	0.234***	0.355***	0.252***
	(0.0416)	(0.0488)	(0.0468)	(0.0484)	(0.0428)
Constant	0.874***	1.042***	1.027***	0.825***	0.957***
	(0.116)	(0.127)	(0.126)	(0.123)	(0.121)
Observations	511	510	509	509	507
R-squared	0.399	0.325	0.329	0.396	0.350

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for bonds issued by non-financial firms to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following three weeks (columns (2), (3), (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table A.5: Basic correlation analysis

	SentIndex
YS_t	-0.0206
YS_{t+1}	0.00958
YS_{t+2}	-0.0253
YS_{t+3}	0.0800
YS_{t+4}	0.0464
N	520

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table reports correlations between the sentiment index and contemporaneous as well as leading yield spreads for our sample period (2004-2014).

B Appendix: Robustness Evaluation

Table B.1: Regression outputs for sub-period 2004-2007 (BB-bonds)

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.387**	0.0598	-0.113	0.329*	0.284
	(0.186)	(0.186)	(0.169)	(0.176)	(0.234)
ADS	1.282	1.588	1.343	1.179	1.267
	(0.945)	(0.975)	(0.971)	(0.893)	(0.986)
EPU	0.00237	-0.00249	0.000206	-0.00140	0.00313
	(0.00368)	(0.00347)	(0.00386)	(0.00443)	(0.00421)
VIX	0.111**	0.102**	0.0811	0.0375	0.0447
	(0.0474)	(0.0494)	(0.0501)	(0.0425)	(0.0440)
YS_{t-1}	0.0316	-0.105	-0.0630	-0.0891	-0.0965
	(0.0679)	(0.0708)	(0.0764)	(0.0951)	(0.0661)
Constant	2.543***	3.255***	3.367***	4.056***	3.975***
	(0.703)	(0.683)	(0.743)	(0.638)	(0.640)
Observations	153	152	151	150	149
R-squared	0.073	0.054	0.034	0.034	0.037

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for junk bonds (BB-rated or less) during 2004-2007 to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following four weeks (columns (2), (3) (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table B.2: Regression outputs for sub-period 2007-2010 (BB-bonds)

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
SentIndex	-0.166	-0.265	0.212	0.156	0.433
	(0.204)	(0.207)	(0.301)	(0.324)	(0.263)
ADS	-1.787*	-2.197*	-2.507**	-1.882	-1.764
	(1.067)	(1.115)	(1.098)	(1.162)	(1.278)
EPU	0.000841	0.00453*	0.00371	0.00174	0.00232
	(0.00356)	(0.00265)	(0.00314)	(0.00349)	(0.00408)
VIX	0.0804***	0.115***	0.135***	0.143***	0.137***
	(0.0160)	(0.0128)	(0.0184)	(0.0190)	(0.0188)
YS_{t-1}	0.511***	0.294***	0.170**	0.0741	0.113
	(0.0720)	(0.0685)	(0.0828)	(0.102)	(0.0812)
Constant	1.151***	1.652***	1.965***	2.402***	2.332***
	(0.301)	(0.321)	(0.355)	(0.407)	(0.326)
Observations	151	150	149	148	147
R-squared	0.723	0.706	0.665	0.625	0.605

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for junk bonds (BB-rated or less) during 2007-2010 to the sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following four weeks (columns (2), (3) (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table B.3: Regression outputs using the re-weighted index

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
WeightedSentIndex	-0.0524	0.0579	0.0654	0.242*	0.214
	(0.111)	(0.120)	(0.122)	(0.133)	(0.146)
ADS	-0.447	-0.175	-0.195	-0.141	-0.182
	(0.732)	(0.778)	(0.731)	(0.732)	(0.788)
EPU	-0.000264	0.000837	0.000441	-5.70e-05	0.00158
	(0.00183)	(0.00193)	(0.00184)	(0.00195)	(0.00196)
VIX	0.0984***	0.118***	0.122***	0.126***	0.124***
	(0.0104)	(0.0105)	(0.0111)	(0.0110)	(0.0119)
YS_{t-1}	0.349***	0.205***	0.187***	0.137***	0.171***
	(0.0488)	(0.0516)	(0.0507)	(0.0518)	(0.0527)
Constant	1.402***	1.742***	1.753***	1.924***	1.798***
	(0.187)	(0.183)	(0.195)	(0.207)	(0.193)
Observations	508	507	506	505	504
R-squared	0.537	0.503	0.492	0.477	0.482

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for junk bonds (BB-rated or less) to the weighted sentiment index. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following four weeks (columns (2), (3) (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table B.4: Regression outputs using alternative words

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
OtherWordsSentIndex	-0.0543	0.0773	0.0493	0.248*	0.202
	(0.113)	(0.114)	(0.120)	(0.131)	(0.145)
ADS	-0.450	-0.173	-0.189	-0.133	-0.171
	(0.733)	(0.777)	(0.732)	(0.733)	(0.792)
EPU	-0.000278	0.000822	0.000497	1.66e-05	0.00168
	(0.00184)	(0.00193)	(0.00183)	(0.00195)	(0.00196)
VIX	0.0984***	0.118***	0.122***	0.126***	0.124***
	(0.0104)	(0.0105)	(0.0111)	(0.0110)	(0.0119)
YS_{t-1}	0.349***	0.205***	0.186***	0.136***	0.170***
	(0.0489)	(0.0516)	(0.0507)	(0.0517)	(0.0527)
Constant	1.402***	1.742***	1.755***	1.926***	1.801***
	(0.187)	(0.183)	(0.195)	(0.207)	(0.194)
Observations	508	507	506	505	504
R-squared	0.537	0.503	0.492	0.477	0.482

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for junk bonds (BB-rated or less) to the sentiment index (based on the new words). The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following four weeks (columns (2), (3) (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Table B.5: Regression outputs using Put-Call Ratio

VARIABLES	(1) YS_t	(2) YS_{t+1}	(3) YS_{t+2}	(4) YS_{t+3}	(5) YS_{t+4}
PutCall	1.272	1.663	1.409	2.361	0.448
	(1.708)	(1.598)	(1.691)	(1.672)	(1.730)
ADS	-0.452	-0.185	-0.187	-0.138	-0.161
	(0.730)	(0.776)	(0.731)	(0.735)	(0.800)
EPU	-0.000244	0.00113	0.000742	0.000670	0.00211
	(0.00186)	(0.00192)	(0.00183)	(0.00196)	(0.00200)
VIX	0.0983***	0.118***	0.122***	0.128***	0.124***
	(0.0104)	(0.0105)	(0.0110)	(0.0111)	(0.0122)
YS_{t-1}	0.350***	0.206***	0.186***	0.134**	0.168***
	(0.0485)	(0.0518)	(0.0507)	(0.0525)	(0.0531)
Constant	1.396***	1.733***	1.751***	1.907***	1.800***
	(0.187)	(0.182)	(0.195)	(0.209)	(0.198)
Observations	508	507	506	505	504
R-squared	0.538	0.504	0.493	0.476	0.480

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This table reports the coefficients of a regression relating weekly average yield spreads for junk bonds (BB-rated or less) to the Put-Call Ratio. The dependent variables include contemporaneous (average) yield spread (column 1) and (average) yield spreads over the following four weeks (columns (2), (3) (4) and (5), respectively). The sentiment index is the independent variable. The change in the macroeconomic conditions (ADS) index, market volatility (VIX), the change in the economic policy uncertainty index (EPU) and a lagged yield spread are included as control variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively.