Bond Short-Interest and Yield Spread Forecasts under Short-Sale Constraints

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Abstract:

This paper investigates the predictive power of bond short interest for future price changes in the bond market. Controlling for stock short interest and bond characteristics, bond short interest has stronger predictive power for future yield spreads when short-sale constraints are more binding. While bond short interest predicts both investment grade (IG) and non-investment grade (NIG) bonds, predictability is higher for NIG bonds. Short-sale constraints make it more difficult for shorting and reduce the adjustment speed of bond prices to private information. As a consequence, it takes longer time to correct bond mispricing and predictability of yield spreads lasts longer.

Keywords: Short interest; bond yield spreads; lending market constraints; financial distress; forecast horizon

1. Introduction

A vast literature shows that short sellers are informed traders capable of predicting adverse corporate events, rectifying security mispricing, and reinstating market efficiency. However, past studies on short sales have focused on stock markets (U.S. G.P.O., 1991; Baidoo, 2021; Lynch, Nikolic, Yan, 2013 et al.; Beneish, Lee, and Nichols, 2015; Engelberg et al., 2022). Similarly, while theories suggest that securities with more stringent short-sale constraints are more overvalued, prior research has mainly investigated this implication in the stock market (Miller, 1977; Diamond and Verrecchia, 1987; Blocher, Reed, and Van Wesep, 2013). Only recently have researcher begun to look into these issues more closely. Hendershott et al. (2020) and Vladimirova et al. (2023) find that equity and bond short interests predict realized returns of high-yield corporate bonds but not for investment-grade bonds, while earlier Asquith et al. (2013) find no return predictability. These papers study predictability of realized returns rather than expected returns. Campello, Chen, and Zhang (2008) show that yield spreads are a more reliable

measure of ex ante expected returns of bonds, which in theory should be the information conveyed by short sellers. Nevertheless, none of the studies on corporate bond return predictability has used this expected return measure in empirical tests. This paper attempts to fill this gap in the literature.

This paper investigate the role of bond short sellers in bond price discovery and predictability of yield spreads. We focus on the predictability of yield spread because it reflects the expected returns, which in theory should represent the information conveyed by short sellers. Investigating predictability of yield spreads therefore provides critical evidence on the time-varying risk premium of corporate bonds, an important asset class comparable in size to stocks. Besides the appealing of being an expected return variable, yield spread is a direct measure of the cost of debt and is commonly used in bond fundamental analysis by traders and investors in the corporate bond market. Understanding the predictability of yield spreads thus has far-reaching implications for corporate financing and bond investment decisions.

Unlike stocks, the literature on bond short selling is quite limited and mainly investigates the sensitivity bond returns to short sellers' information. The literature provides mixed evidence on whether bond short sellers are informed. Asquith, Au, Covert, and Pathak (2013) conduct the first study on the informativeness of short sellers and find no evidence of short sellers being informed. Asquith et al. (2013) suggest that a sizable portion of bond short interest is for hedging purposes, which may explain the relatively low correlation between equity and bond short interests[1]. Using a longer time-series dataset, Hendershott et al. (2020) find a weak relationship between the level of shorting in bonds measured by short interest and subsequent bond returns. Nevertheless, they find that short interest predicts bond returns in high-yield or non-investment-

[1] Asquith et al. (2013) suggest that a significant proportion of bond shorting is used for the purpose of hedging unrelated to private information. Our result is consistent with this view.

grade (NIG) bonds after Lehman's collapse in 2008. They attribute the predictability of NIG bond returns to increased uncertainty and higher default risk during the financial crisis together with Lehman's collapse, increased funding costs and frictions for arbitrage capital, and higher profitability in high yield bonds and increases information sensitivity to short sellers' information.

This paper is motivated by three important reasons. First, given the controversy in bond predictability issue, additional evidence using yield spreads as a predicted variable will help shed light on the mixed findings in the literature. One possibility is that realized returns are a noisy measure of bond expected return, which in theory is the true information possessed by short sellers posited by the model (see Diamond and Verrecchia, 1987). Since using realized returns as a proxy of expected returns incurs measurement errors, it can produce unstable test results, especially when the sample period is short. This may explain the controversy in empirical findings. Second, aside from documenting additional evidence using a more accurate expected return measure, our study of bond predictability through the lens of yield spreads provides important information for determination of the time-varying bond risk premia and costs of debt, which are crucial elements in corporate choice of capital structure and security design. Third, the role of bond short-sale constraints in affecting the information content of short sales and bond price predictability has never been explored[2]. Existing theories offer three predictions for short-sale constraint effects. First, assets with more binding short-sale constraints are likely to be more overvalued and gain lower returns in the future (see Miller, 1977; Blocher et al., 2013). Second, short-sale constraints hinder less informed short sellers from participating, and allow only more informed ones to engage in the trades. As such, shorting constrains strengthen the signal of short

[2] [2]The role of bond short interest is unexplored in Kecskés et al. (2013).

sales (Diamond and Verrecchia, 1987), which implies stronger return predictability. Third, theory suggests that short-sale constraints will slow down the speed of price adjustment to private information, as shorting constraints prohibit some (lower signal) short sellers from shorting in the market. However, these theoretical predictions for the effects of short-sale constraints are based on the premise of stock markets. It is unclear whether they may hold in the corporate bond market.

Using a comprehensive dataset of bonds, we uncover new evidence that contributes to the current literature. First, we find that bond short interest, as a measure of bond short-seller information, has a strong predictive power for future yield spreads for both investment (IG) and non-investment grade (NIG) bonds. This finding contrasts sharply with past studies that either find no predictability or only predictability in high-yield bonds. The yield spread predictability is of economic significance with a long-short spread of 0.95 percent per month and is robust to various controls.

Second, the yield spread predictability is much higher for NIG than for IG bonds. For example, the long-short portfolio spread is 0.94 percent per month for NIG bonds whereas it is only 0.07 percent for IG bonds. The results suggest that predictability is more than 10 times higher for NIG bonds. One plausible return that NIG bonds have higher predictability is that these bonds have higher default risk and their payoffs resemble stocks.

Third, yield spread predictability is higher when short-sale constraints are more binding. This predictive relationship is stronger for NIG bonds than for IG bonds. The results show that short-sale constraints strongly affect the price discovery of corporate bonds. These results are robust to

controls for the effect of stock short interest, uses of different measures of short-sale constraints.[3] The strong predictability is confirmed by both portfolio and regression analyses. The results show that predictability permeates in bonds of all rating categories.

To further examine the predictability of future expected returns associated with bond short interest, we calculate the difference (change) in yield spreads. We then adjust yield spread change by time to maturity and use it as the dependent variable, which serves as a proxy for expected returns. The analysis controls for the same independent variables. We continue to find a similar pattern of predictability using this expected return measure. The results suggest that yield spreads can be regarded as a proxy for future expected returns in the corporate bond market and our results are robust to using these measures.

Finally, we find that the yield spread predictability associated with short-sale constraints last longer when there are higher short-sale constraints. Put it differently, the rate of convergence for yield spreads to new equilibrium after incorporating current information is lower when bond short-sale constraints are higher. This evidence strongly supports the prediction of the Diamond-Verrecchia (1987) model that short-sale constraints reduce the adjustment speed of bond prices to short sellers' negative private information. Thus, short-sale constraints impede the information assimilation process and reduce the information efficiency in the corporate bond market.

This paper contributes to the literature of short sales. First, extending the study of Hendershot et al. (2020), we find strong predictability in bond yield spreads, not only for non-investment-grade (high yield) bonds but also for investment grade bonds. We attribute this stronger predictability to the use of yield spreads as a better measure of expected returns (see Campello,

[3] These short-sale constraint measures include utilization rate, Markit's daily cost of borrow score (DCBS), and short interest to institutional ownership.

Chen, and Zhang, 2008) behind the short sellers' private information. Second, for the first time, this paper study the effect of bond short-sale constraints on the predictive power of short interest for future yield spreads. Third, the paper document evidence that predictability of yield spreads is dominated by distressed (NIG) bonds. This evidence echoes the literature that financial distress plays a special role in asset pricing and return predictability.

2. Data:

2.1 Data description:

We sourced our short-sale data from two primary channels. Real-time security lending data are obtained from the IHS Markit database, accessible since May 2002. This dataset includes daily information on total shares on loan for each stock, and the Short Interest Ratio (SIR) is computed as the demand quantity, derived by dividing the quantity in shares on loan in Markit by the shares outstanding[4]. Additionally, exchange-disclosed stock short interest data are collected from the Compustat database, offering monthly stock short interest data for each stock starting from 1973 (from 2007 onwards). Furthermore, Markit calculates a daily cost of borrowing score (DCBS) as a metric for the relative cost of borrowing for each stock, graded on a scale from 1 (low cost) to 10 (high cost). Leveraging this data, we create a "specialness" measure, akin to the approach outlined by Beneish et al. (2015). Furthermore, we employ the variable Utilization to measure the extent of shorting constraints. Utilization represents the proportion of lendable shares that

[4] The bond short sale data are available from September 2006, and we use the calendar month-end observations in monthly analysis.

have been borrowed by Markit borrowers. A higher Utilization value indicates more stringent short-sale constraints, signifying a reduced availability for security borrowing[5].

Monthly corporate bond data are sourced from WRDS, encompassing information on bond yields, maturities, ratings, and various other bond attributes. Corporate bond trading data are obtained from the enhanced TRACE database, which captures transactions of all publicly traded corporate bonds starting from July 2002. This database furnishes details such as the time, price, and quantity of bond transactions. Following to the data screening process outlined in Bessembinder, Kahle, Maxwell, and Xu (2009), we exclude canceled, corrected, commission, and small (below $100,000) trades.

To enhance accuracy, bond-specific information is retrieved from the Mergent Fixed Investment Securities Database (FISD). The FISD database comprises issuance details for all fixed-income securities with a CUSIP, encompassing information on coupon rates, issue date, maturity date, issue size, ratings, and other relevant characteristics. Utilizing this bond characteristic information from FISD, we identify and eliminate non-US dollar-denominated bonds, as well as bonds backed by mortgages or other assets. The sample period for this study spans from July 2002 to September 2020.

2.2 Variables used in empirical tests:

We compute the aggregate demand for bond Short Interest Ratio (SIR) by summing the total number of bonds on loan as reported by Markit over the whole bond issuance from FISD. Given that Markit's lending data encapsulates 90% of the market capitalization of CRSP firms, the

[5] Beneish et al. (2015) show that this variable has a monotonic relation with values of *DCBS*.

coverage is reflective of the entire market. The Markit short interest data are particularly apt for short-term dynamic analyses and predictions. Additionally, the stock Short Interest Ratio is derived by scaling the monthly short interest level with the total shares outstanding from the Center for Research in Security Prices (CRSP) database.

To assess the extent of lending constraints, we employ loan utilization rates, Daily Cost of Borrowing Score (DCBS), and Short Interest Ratio divided by Institutional Ownership (SIR/IO). Specifically, we introduce a Special dummy variable, assigned a value of one if a stock's DCBS is equal to two or greater, and zero otherwise (as per Beneish et al., 2015). Additionally, we incorporate the variable Utilization as a measure of shorting tightness, indicating the percentage of lendable shares that are loaned out to Markit borrowers. A higher Utilization value signifies a more stringent short-sale constraint, suggesting reduced flexibility for bond borrowing. Finally, we utilize SIR/IO as a metric for gauging demand over supply. A higher value of this ratio signifies a more pronounced constraint in the bond market. The data pertaining to institutional ownership is sourced from the EMAXX dataset. we incorporate dummy variables, denoted as D_u and D_i, with a value set to one if the utilization rate or the SIR/IO rate exceeds the third quartile of the distribution, indicating a state of high short-sale constraint. Conversely, their value is set to zero if these rates fall below or equal to the third quartile. Regarding DCBS, as we mentioned, we establish a cutoff point at 2, defining the dummy variable D_d. This dummy variable takes on a value of 1 when the DCBS value exceeds 2, and 0 otherwise.

The yield spread is determined as the variance between the yield to maturity on a corporate bond and that on a duration-equivalent Treasury security. Monthly corporate bond yields to maturity can be easily accessed in the WRDS database. The yield to maturity on a Treasury security is derived from the constant-maturity yield provided by the Federal Reserve Bank.

we integrate data from various sources and necessitate non-missing values for crucial variables. The ultimate sample comprises 481,812 bond-month observations. Table 1.1 presents the descriptive statistics for variables with monthly observations. The mean of the bond Markit short interest ratio SIR is about 2.0% and the mean of the exchange-disclosed short interest ratio SIR Stock is about 4.0%. The observed smaller value for bond SIR is expected, given that the Markit data is obtained from a consortium of affiliated institutional lenders[6]. The mean yield spread is 2.50 %, the average time to maturity and bond age are 9.78 and 4.15 years, respectively. In Table 1.2, the correlation matrix illustrates the relationships between monthly observations of key variables employed in empirical tests. The correlation between Short Interest Ratio (SIR) and future yield spread (YS) is 0.14, suggesting a moderate correlation at the monthly level. Additionally, equity short interest (SIR Stock) and bond short interest (SIR) exhibit a moderate correlation, with a coefficient of approximately 0.23. The relatively low correlation between equity and bond short interests could be attributed, in part, to the insights provided by Asquith et al. (2013). Their suggestion that a substantial portion of bond short interest serves hedging purposes may offer an explanation for this observed pattern. It's noteworthy that all constraint variables show positive correlations with both SIR and future yield spread. This suggests a potential positive influence on the predictive power of SIR.

3. Empirical Results:

While Hendershott et al. (2020) explored the potential predictive capability of stock Short Interest Ratio (SIR) for future bond returns, implying information transfer from the liquid stock

[6] Markit provides the data at a monthly frequency in 2002 and 2003, a weekly frequency from August 2004, and a daily frequency from July 2006. In monthly analysis, we use the month-end observation for each stock.

market to the bond market, without acknowledging the potential impact of short-sale constraints in the stock market on results in bond markets, this paper provides additional insight. Specifically, it supplements the discussion by focusing on information that is already integrated into the bond market. Consequently, the analysis delves into the predictive power of bond Short Interest Ratio for future bond yield spreads, taking into account the short-sale constraints prevalent in the bond markets. Similarly, since bonds and stocks represent contingent claims on the assets of the same firm, the impact of bond short interest on yield spreads is expected to be more pronounced when bond short-sale constraints are more restrictive. In the subsequent analysis, we explore these scenarios through both portfolio and regression analyses.

3.1 Portfolio analysis:

3.1.1 Base line analysis:

we start analysis with portfolio sorts to examine whether bond short interest can predict future bond yield spreads without imposing constraints. At the beginning of each month (t), we sort bonds into quintile portfolios (P1 to P5) on issuers' bond short interest ratio (SIR) in the previous month (t-1). Portfolio P1 comprises bonds with the lowest bond short interest, while P5 includes bonds with the highest bond short interest. The holding period is one month, and portfolios are rebalanced monthly. Table 2.1 presents the average yield spread in month t for each portfolio and the difference in the average monthly yield spreads between P5 and P1 (P5-P1). Panel A in Table 2 showcases the results for the full sample, letter rating categories as well as investment- and non-investment-grade bond groups, respectively.

In the first row of Panel A, the average yield spreads of quintile portfolios are presented for the full sample, encompassing all rated bonds. Notably, yield spreads exhibit a monotonically increasing trend with bond short interest. The highest SIR portfolio reflects a substantially higher yield spread (3.22%) compared to the lowest SIR portfolio (2.18%). The difference in average yield spreads between the highest and lowest quintile portfolios amounts to 1.04% for the value-weighted portfolios, and this difference is highly significant (P = 1.18E-52). Similar patterns are observed in the equal-weighted portfolio results, emphasizing a strong predictive power of bond short interest for future bond yield spreads. While the magnitude of this difference and yield spreads is comparatively smaller than equity SIR in Xu et al.'s (2023) study, it aligns with the assumption that bond markets tend to be more stable and hesitant in reacting to negative signals from the overall market, as equity is predominantly considered when facing overpricing (Asquith et al., 2013).

The literature indicates that bond price sensitivity to information varies by firms' default risk (Easton et al., 2009). Thus, examining bond short interest across different ratings is crucial for understanding short-sale effects more thoroughly. We firstly examine the impact of short sales on yield spreads, focusing on investment-grade (IG) and non-investment-grade (NIG) groups in Panel A. The outcomes reveal a notable contrast in the predictability of yield spreads for NIG and IG bonds. As anticipated, the P5-P1 spread is 1.17% (P = 2.46E-10) for NIG bonds, which is approximately twelve times the P5-P1 spread for IG bonds (0.10%). This pattern is similarly observed in the P5-P1 yield spreads under the equal-weighted scheme. However, it is essential to note that the returns, in general, remain significantly smaller than those observed in portfolios sorted by stock short interest ratio (SIR Stock). Nevertheless, it is noteworthy that both investment-grade (IG) and non-investment-grade (NIG) bonds appear to exhibit a positive

predictive power for future yield spreads in the bond market, even without accounting for constraints.

Since time series effects are not captured by conventional portfolio sorting, we further analyze yield spread fluctuations over time using a time series plot, shown in Appendix Figure 1. The figure contains three panels A, B and C representing yield spread differences from May 2005 to April 2006 for the full sample, non-investment-grade (NIG) bonds, and investment-grade (IG) bonds. The x-axis shows the trading year, and the y-axis displays the percentage difference in future yield spreads. The red, blue, and green lines represent the yield spreads for portfolio 5, portfolio 1, and the percentage difference between the high and low portfolios, sorted by the short interest from the previous month.

In Panel A, all yield spread differences are positive, while NIG and IG bonds in Panel B and C show brief periods of negative differences. Notably, NIG bonds exhibit more volatile fluctuations over time compared to IG bonds, both in the short and long term, indicating a greater sensitivity to short interest change—consistent with Hendershott et al. (2020).

We also present the portfolio analysis by letter rating categories. As shown, the effect of short interest increases consistently with bond ratings and differs significantly across risk levels. The predictive power of SIR is relatively lower for AAA/AA bonds, with a P5-P1 spread of 0.17 for the value-weighted portfolio sorting, though it remains statistically significant. There is a marked increase in SIR's predictive power at the speculative-grade threshold. For BB-D rated bonds, the P5-P1 spread reaches 1.41% (1.17) with a p-value of 3.23E-18 (2.66E-20) for value-weighted (equal-weighted) portfolios—roughly six times that of BBB-rated bonds.

In summary, compelling evidence suggests that credit risk significantly contributes to the predictability associated with short interest. Furthermore, in contrast to findings by Asquith et al. (2013) and Hendershott et al. (2020), our research indicates the existence of predictability in both investment-grade and non-investment-grade bonds.

3.1.2 Effect of short-sale constraints:

Short sellers encounter limitations when attempting to sell stocks short. Theoretical perspectives propose that firms with elevated short-sale constraints are prone to being more overpriced. To quantify these constraints, we employ three metrics: bond utilization, Daily Cost of Borrowing Score (DCBS), and Short Interest Ratio divided by Institutional Ownership (SIR/IO). In this study, on a monthly basis, we initially sort bonds into Short Interest Ratio (SIR) quintiles for the previous month. Next, within each group, we split the bonds into two halves based on the previous month's short sale constraints, measured by Utilization, DCBS, and SIR/IO. We then report both value-weighted and equal-weighted yield spreads for these portfolios at time t. The hypothesis posits that the predictability of bond yield spreads at time t, as indicated by bond short interest at time t-1, will be more pronounced for bonds with higher bond short-sale constraints.

The results in Panel B, C and D for Table 2.2 support the assumption. In Panel B, it is evident that for the entire sample, the P5-P1 spreads consistently rise with the loan utilization rate. For instance, within the high utilization tercile, the long-short yield spread is 1.94% (2.16%) for value-weighted (equal-weighted) portfolios, yielding highly significant results (P = 1.41E-48 and P = 6.52E-51, respectively). In contrast, the spread is merely 0.37% (0.42%) for the low

utilization tercile, with significant P-values of 1.90E-17 and 1.89E-24. Upon segmenting the bond sample into investment-grade (IG) and non-investment-grade (NIG) groups, the pattern persists, revealing that the predictability of yield spreads amplifies with higher short-sale constraints. Economically, this predictability is notably more pronounced for NIG bonds. Specifically, for IG bonds, P5-P1 spreads are generally smaller, even in the high utilization tercile, where the P5-P1 spread is only 0.18%. In sharp contrast, for NIG bonds, the P5-P1 spread reaches 2.02% under high utilization rates. These results underscore that the predictive power of short interest for future bond yield spreads is contingent on the level of short-sale constraints, with much stronger predictability observed for NIG bonds.

Panel C presents the outcomes utilizing Daily Cost of Borrowing Score (DCBS) as an alternative short-sale constraint measure in portfolio sorts. A higher DCBS value signifies a greater borrowing cost, imposing a more substantial constraint on short sales. The findings reveal that P5-P1 spreads are more extensive when lending fees are elevated. Notably, there is a substantial increase in the P5-P1 spread for non-investment-grade (NIG) bonds. In high DCBS portfolios, the disparity in value-weighted yield spread between high and low Short Interest Ratio (SIR) quintiles is merely 0.14% for investment-grade (IG) bonds, whereas it surges to 1.72% for NIG bonds.

Finally, we replace Short Interest Ratio divided by Institutional Ownership (SIR/IO) as an alternative measure of short-sale constraints. SIR/IO serves as an indicator of short sale demand over supply, where a higher value implies a more substantial short-sale constraint. Panel D illustrates a comparable pattern in the impact of short-sale constraints, and once again, the predictability is notably more robust for non-investment-grade (NIG) bonds.

In summary, the findings collectively indicate that the impact of short interest becomes more significant with increasing short-sale constraints, irrespective of the measure employed. The predictive ability of bond short interest for future yield spreads is stronger when bond short-sale constraints are more restrictive, with this effect being notably more substantial for non-investment-grade (NIG) bonds.

3.2 Regression analysis:

3.2.1 Base line regression:

The portfolio analysis presented above indicates that short-selling activity in the bond market predicts corporate bond yield spreads, with the predictability being more robust for companies exhibiting higher credit risk and greater bond short-sale constraints. To further validate this hypothesis, we conduct cross-sectional regression tests with multiple controls. The cross-sectional predictive regression is executed month by month using the Fama-MacBeth (1973) methodology:

$$YS_{i,t} = \alpha + \beta_1 SIR_{i,t-1} + \beta_2 SIR_{i,t-1} * D_{i,t-1} + \beta_3 SIR_Stock_{i,t-1} + \beta_b X_{i,t-1} + u_{it} \quad (1)$$

where $YS_{i,\,t}$ is the bond yield spread and SIR is the bond short interest. The variable $SIR_{i,\,t-1} * D_{i,\,t-1}$ captures the interaction effect of short interest and short-sale constraints (Rating) where $D_{i,\,t-1}$ takes a value of 1 for high utilization rate (D_u), high borrowing cost (D_d), or high SIR/IO (D_i) and high Rating (NIG). A positive coefficient for these variables implies a stronger impact of SIR when short-sale constraints are elevated, particularly for NIG bonds. we incorporate controls for the effects of stock SIR (SIR_Stock) and bond characteristics (B), including bond size, maturity, age, coupon, Amihud illiquidity, callability, and ratings.

Table 3 presents the baseline regression results. In Column 1, the univariate regression on Short Interest Ratio (SIR) reveals a highly significant coefficient of 0.069 ($p < 0.01$). This SIR effect is economically significant, indicating that a 1% increase in SIR leads to a 0.069% increase in monthly yield spreads. After incorporating controls for bond characteristics in Column 2, the coefficient of SIR slightly decreases but remains highly significant. In Column 3, the addition of SIR * NIG examines the interaction between bond short interest and financial distress. The coefficient for this variable is 0.022 and highly significant ($p < 0.01$). Although the coefficient on SIR is still significantly positive, it becomes smaller, suggesting weaker predictability for investment-grade bonds. In Columns 4, 5, and 6, we explore the effect of SIR in the context of bond short-sale constraints. The coefficients of the three interaction variables are all significant, indicating that the predictive power of bond short interest for future yield spreads is considerably stronger for bonds issued by firms facing high bond short-sale constraints.

One interesting part of these Table 3 is the negative signs on SIR (bond short interest) when high short sale constraints are considered. The negative coefficient on SIR suggests that, after accounting for bond-specific controls and the interaction with the short-sale constraint variable D_u, D_d and D_i, an increase in short interest alone is associated with a decrease in future yield spreads. This could suggest that markets expect bonds with higher short interest to improve in credit quality or risk premium, leading to a narrowing of the yield spread. One possible explanation would be risk transfer and liquidity premium. Amihud and Mendelson (1986) suggest that more liquid securities tend to have lower yields (tighter spreads) because investors require less compensation for holding more liquid, tradeable assets. In an environment with low short-sale constraints, the presence of short sellers could increase liquidity in the bond market. More liquidity reduces the liquidity premium embedded in the yield spread, leading to a

narrowing of spreads. Short interest, in this case, signals that liquidity is available in the market, which, in turn, leads to a decrease in spreads. Another explanation for the negative coefficients is overreaction to initial negative sentiment, which means when there are few short-sale constraints, the initial shorting activity might represent an overreaction to negative news or sentiment. As more information becomes available, markets correct this overreaction, resulting in a narrowing of the yield spreads. This phenomenon is similar to the overreaction hypothesis in stock markets, where initial overreactions are corrected over time. As supported by De Bondt and Thaler (1985), who introduced the overreaction hypothesis, which suggests that markets often initially overreact to new information, but prices correct over time as further information is digested. To sum up, In the absence of short-sale constraints, bond short interest could signal increased liquidity, or corrections of overreactions to initial negative information. This results in tighter yield spreads as bond prices adjust to reflect more favorable conditions or lower credit risk, this similar trend also shows in the following regressions when short sale constraints are considered.

3.2.2 Sub-sample test:

Is the impact of short-sale constraints more pronounced for non-investment-grade (NIG) bonds? To address this inquiry, we conduct an additional subsample analysis for both investment-grade (IG) and NIG bonds, employing the same dependent, independent, and control variables as those in the baseline model. The results in Table 4 indicate that the effect of short-sale constraints is even stronger for non-investment-grade (NIG) bonds. In the subsample test conducted for investment-grade (IG) and NIG bonds, using the same dependent, independent, and control variables as in the baseline model in Table 3, all the interaction variables are significantly positive. Moreover, the magnitude of the interaction effect is higher and more robust for NIG

bonds. This implies that the interaction effect of short interest and short-sale constraints is notably stronger for speculative-grade bonds. Furthermore, both IG bonds and NIG bonds exhibit positive and robust predictive power for future yield spreads in the subsample test, aligning with the findings from the baseline model and portfolio-sorting results.

3.2.3 Differencing in yield spreads:

Changes in yield spreads are negatively related to bond return, this negative relationship is widely explored in bond market literature, where an increase in yield spreads often indicates higher future interest rates, leading to lower bond prices and returns, and vice versa. For instance, it is primarily documented in the works of Fama and Bliss (1987) and Campbell and Shiller (1991), who demonstrated the predictive power of the term structure for future bond returns and its inverse relationship with yield spreads. In addition, the idea that the negative product of the change in yield spreads and maturity (when using logarithmic terms) approximates bond returns is often attributed to Campbell and Shiller's (1991) work on the log-linear present value model. Additionally, Cochrane and Piazzesi (2005) discussed yield spreads in a predictive context for bond returns using similar approximations.

Since on the previous studies that already showed a negative correlation between the yield spread and bond returns; in this part, we want to conduct a robustness check for the predictive power of the bond SIR for future bond returns by taking the difference in yield spreads as dependent variable, in order to see if the results are similar to the baseline results. The change in yield spread is often considered a proxy for bond returns in the bond market (Fama and Bliss, 1987; Campbell and Shiller, 1991). As yield spread reflects the additional compensation investors

demand for holding a bond with credit risk compared to a risk-free bond (usually a government bond) with the same maturity. When the yield spread narrows, it suggests that the market perceives lower credit risk, and vice versa. The change in future yield spread is defined in equation (2). Specifically, the dependent variable named the difference of future yield spread at time t for firm i is defined as:

$$DYS_{i,t} = YS_{i,t} - YS_{i,t-1} \tag{2}$$

Which represents the change in yield spread within a one-month time period. As we keep the same independent variables and control variables, the base line Fama-MacBeth regressions now is:

$$DYS_{it} = \alpha + \beta_1 SIR_{i,t-1} + \beta_3 SIR_Stock_{i,t-1} + \beta_b X_{i,t-1} + u_{it} \tag{3.1}$$

The results of these regressions based on the full sample, NIG bonds and IG bonds are listed in Table 5.1 separately, providing a robustness check for the main panel regressions using the following equation (3.2).

$$DYS_{it} = \beta_1 \cdot SIR_{it} + \beta_2 \cdot SIR_{it} \cdot D_{it} + \beta_3 \cdot SIR_Stock_{it} + \sum_{t=1}^{T} \gamma_t \cdot MonthDummy_t + \alpha_i + \varepsilon_{it} \tag{3.2}$$

This time, the dummy variable $D_{i,t}$ captures the interaction effect of short interest and short-sale constraints. The fixed effects panel data regression results, shown in Table 5.2, control for both time and month fixed effects. The strength and statistical significance of the coefficients associated with the Short Interest Ratio (SIR) in columns 1 and 2 remain robust, demonstrating a strong predictive capacity for bond SIR. Additionally, the coefficient for non-investment-grade

(NIG) bonds is 0.521, significantly larger than the 0.2 coefficient observed in the full sample, indicating that NIG bonds have a dominant influence in predicting future returns.

Notably, the magnitude of the coefficients in columns 4, 5, and 6 is comparable to those in Table 3 when considering the interaction term, suggesting that yield spread effectively serves as a metric for anticipating future expected returns. The interaction terms involving the constraint dummy are both statistically significant and positive, signifying a negative predictive relationship between SIR and bond returns, as changes in yield spreads are negatively correlated with returns.

In contrast, column 3 reveals that the sub-sample regression for investment-grade (IG) bonds, with a coefficient of 0.028, does not exhibit significant predictive power when the dependent variable is the future difference in yield spreads. This aligns with Hendershott et al. (2020), who conclude that bond returns are predictable only for NIG bonds when the difference in future yield spreads is used as a proxy for expected returns. The disparity between NIG and IG bonds is consistent with the theory that NIG bonds (high-yield or junk bonds) are more sensitive to changes in credit risk and economic conditions due to their lower credit ratings (Altman 1989; Campbell and Taksler 2003). This sensitivity leads to more pronounced fluctuations in yield spreads for NIG bonds, which in turn serve as better predictors of future yield spread changes.

A key difference for IG bonds, compared with the regression in Table 3, is that the strong predictive power disappears when the dependent variable shifts from future yield spreads to the difference in future yield spreads. This is attributed to the theory that the difference in yield spreads reflects smaller, less predictable changes. When the dependent variable becomes the difference in future yield spreads ($YS_{t+1} - YS_t$), the predictive power of short interest weakens because such differences are influenced by short-term fluctuations, noise, and unpredictable

market conditions. Studies on bond market dynamics, yield spread behavior, and volatility discuss how yield spreads, especially for less volatile instruments like IG bonds, tend to move gradually rather than dramatically, making smaller changes more difficult to predict due to market noise and short-term fluctuations (Collin-Dufresne et al. 2001; Longstaff and Schwartz 1995; Duffie and Singleton 1999). Interestingly, the short- and long-term sensitivity differences between NIG and IG bonds in response to SIR align with the portfolio sorting results shown in Appendix Figure 1.

In summary, changes in yield spreads serve as a proxy for bond returns because they reflect the market's perception of credit risk, thus isolating credit-related factors from interest rate influences. The results in Table 5 confirm the strong predictive power of SIR for future returns, particularly for NIG bonds. This predictive power is even more pronounced under high short-sale constraints.

3.2.4 Partial adjustment process under short-sale constraints:

The methodology employed in this paper closely resembles that of Xu et al. (2023), particularly in the utilization of a partial adjustment model for analyzing changes in yield spreads in response to information arriving from short sellers, encapsulated in changes in short interest. The theoretical foundation draws from Diamond and Verrecchia (1987), whose work demonstrates that short-sale constraints impeding traders from shorting lead to a reduction in the speed of price adjustments to private information. In contrast to Xu et al.'s (2023) paper, the focus in this study shifts to bond Short Interest Ratio and bond short sale constraints, departing from the emphasis

on equity SIR and equity short sale constraints. The partial adjustment model of yield spread changes to the short-seller private information can be written as:

$$YS_{i,t} - YS_{i,t-1} = \lambda\left(YS^{*}_{i,t} - YS_{i,t-1}\right) - \lambda^{-}\left(YS^{*}_{i,t} - YS_{i,t-1}\right) * D \quad (4)$$

where $YS_{i,t}$ is the current yield spread, $YSi,t*$ is the equilibrium (latent) yield spreads of bond i on day t that incorporates short-sellers' private information, and λ is the speed-of-adjustment coefficient, $\lambda^{-} > 0$ and D is set to 1 for firms with a high short-sale constraint and zero, otherwise, resulting in a slower rate of adjustment for constrained firms in the short run. Assuming that the short seller possesses confidential information regarding the actual (latent) value of the bond, the equilibrium yield spread can be formulated as follows:

$$YS^{*}_{i,t} = a_0 + a_1 TDQ_{i,t} + \sum_j b_j Z_{i,j,t} + \varepsilon_{i,t} \quad (5)$$

where we use Markit's bond loan data (TDQ) as the short interest variable that contains private information, $Z_{i,j,t}$ includes other fundamental variables that affect yield spreads of defaultable bonds, a_0 captures the effect of potential missing factors, and $\varepsilon_{i,t}$ is the disturbance term. In this study, since we are working with monthly data, the TDQ is equivalent to the previously employed bond SIR data. Combining the listed two equations together, we have:

$$YS_{i,t} - YS_{i,t-1} = \beta_0 - \lambda YS_{i,t-1} + \lambda^{-} D * YS_{i,t-1} + \beta_2 TDQ_{i,t} + \sum_j \gamma_j Z_{i,j,t} + u_{i,t} \quad (6)$$

The coefficient of the interaction variable $D * YS_{i,t-1}$ in (6) captures the effect of short-sale constraints on the speed of yield spread adjustment. The partial adjustment coefficient is λ for bonds issued by firms with no (or low) short-sale constraint (D = 0) and is λ^{-} for bonds with a (high) short-sale constraint (D = 1).

We employ utilization rates, Daily Cost of Borrowing Score (DCBS), and Short Interest Ratio divided by Institutional Ownership (SIR/IO) as indicators of short-sale constraints to assess their

impact on the pace of adjustment to private information held by short sellers. The characteristics considered encompass fundamental and variables commonly found in the literature that influence bond value. These include issue size, maturity, age, coupon, ratings, firm size, book-to-market ratio, profitability (net profit margin), idiosyncratic volatility, and leverage (debt-to-asset ratio). Subsequently, we conduct cross-sectional regression and estimate the regression for changes in yield spread at the monthly frequency and present the average coefficients and t values utilizing the Fama-MacBeth (1973) methodology. Table 6 presents compelling evidence of partial adjustment in yield spreads.

The coefficient of the interaction variable $D * YS_{i,t-1}$ is consistently positive and highly significant with 0.038 for high utilization, 0.124 for high DCBS, and 0.030 for high SIR/IO, irrespective of the short-sale constraint variable used. This indicates that the adjustment speed of yield spreads to private information held by short sellers is slower when firms encounter higher short-sale constraints. The findings robustly confirm the expectations of the Diamond-Verrecchia model, indicating that short-sale constraints diminish the speed at which bond prices adjust to private information held by short sellers. Consequently, the lasting predictive power of short interest is more pronounced for bonds issued by firms facing higher short-sale constraints.

3.2.5 Sources of the short interest predictive power：

The literature suggests that the predictive power of short interest can vary across firms of different characteristics. Specifically, Pownall and Simko (2005) demonstrate that short interest becomes more informative for companies with limited analyst coverage, as disclosures of short sales compensate for the absence of extensive analyst guidance. Deshmukh, Gamble, and Howe

(2015) discover that short-sellers tend to focus on companies exhibiting weak operational performance, and the level of short interest proves to be more predictive for riskier enterprises. Diamond and Verrecchia (1987) propose that short interest serves as a stronger predictor of future returns for companies that are overvalued when facing higher arbitrage frictions. In this section, we will analyze company attributes associated with information asymmetry, risk, and arbitrage frictions. This examination aims to provide further insight into the predictive capacity of short interest, building upon the findings from the aforementioned literature.

In order to analysis the potential sources of the short interest predictive power. This paper interacts the bond short interest (SIR) with the firm dummy variables involved leverage ratio (Leverage), net profit margin (Profitability), dispersion in analysts' forecasts (Dispersion), number of analysts following (Coverage), market capitalization (Size), idiosyncratic volatility (IVOL), and bond Amihud illiquidity (Illiquidity). The variables indicate the following relationships: Firms exhibiting high levels of leverage, volatility, and analyst forecast dispersion (indicative of information uncertainty), along with low profitability, tend to be riskier and associated with heightened uncertainty. Conversely, companies with low liquidity often face elevated trading costs, while those with low analyst coverage and capitalization experience greater information asymmetry. These conditions result in increased barriers to arbitrage, potentially leading to greater mispricing of their securities. Consequently, such firms demonstrate higher predictability associated with short interest. The dummy variable Dx takes a value of one if Leverage, Dispersion, IVOL, and Illiquidity are above their cross-sectional median values. For Profitability, Coverage and Size, Dx takes a value of one if they are below their cross-sectional median values. Bond controls include bond size, maturity, age, coupon,

Amihud illiquidity, callable dummy, and rating. The regression results are shown below in Table 7.1.

It's clear that the interaction terms SIR:Dx show consistent positive significance across scenarios involving limit to arbitrage, information asymmetries, and high uncertainty, except for instances of low liquidity. In these cases, no notable interaction term is observed, suggesting that illiquidity doesn't hinder insiders' short selling activities. One possible reason why illiquidity doesn't hinder insiders' short selling activities could be that insiders possess superior information about the market and specific securities. They may be able to accurately predict price movements even in illiquid markets, allowing them to execute profitable short sales despite the lack of liquidity.

To examine how sensitive credit ratings are to firm characteristics, we introduce an additional interaction between the variable SIR:Dx and the bond credit indicator NIG. Subsequently, we re-run the regression, and the outcomes are presented in Table 7.2.

All the interaction terms TDQ bond:Dx:NIG are significant and positive, indicating a stronger predictive power of bond short interest (SIR) under low arbitrage conditions and with risker ratings (NIG). For these companies, obstacles to arbitrage are more pronounced, potentially resulting in increased mispricing of their securities. This, in turn, leads to heightened predictability linked to short interest. In summary, the findings indicate that short interest serves as a more potent predictor for firms facing greater obstacles to arbitrage, information asymmetries, and uncertainty.

3.2.6 Direct Causality vs. Spillover Effects using the Regulation SHO pilot program:

In this section, we undertake a natural experiment conducted between May 2, 2005, and April 28, 2006, initiated by the Securities and Exchange Commission (SEC) to ascertain the causal effect. Specifically, the Regulation SHO program allows pilot stocks to be exempted from the “uptick rule”. During the subprime crisis, there was a significant constraint in arbitrage capital, particularly intensified during the period surrounding Lehman's collapse[7]. The pilot stocks, referred to as treatment firms in this program, experienced a relaxation of short sales constraints following the suspension of the "uptick rule." Ideally, this process can conduct a causality test for stocks short selling predictive power.

While the suspension of the uptick rule was a policy change targeting stocks, it had potential spillover effects into the bond market. This means that: The relaxation of short-sale constraints on stocks could lead to increased shorting activity in the equities of treatment firms, which might reflect broader investor sentiment regarding the firm’s financial health or default risk; This change in sentiment would likely influence the firm's credit risk, which is closely tied to the pricing of its bonds. Investors who are shorting the firm's stock may also bet against the firm's bonds, expecting increased credit risk, leading to an increase in bond short interest. Based on the assumptions above, it is also worthwhile to conduct a test examining the relationship between bond SIR and future yield spreads within the context of the program.

Specifically, the pilot firms are sourced from the SEC website, while the control firms comprise those listed in the Russell 3000 index but excluded from the pilot program[8]. Utilizing this sample, we examine whether the favorable predictability of bond short interest for future yield spreads

[7] See Duffie (2010); Mitchell and Pulvino (2012); Chen, Da, and Huang (2019); and Lin, Man, Wang, and Wu (2020).

[8] There are 2,887 stocks and 948 stocks in the Russell 3000 index and pilot program, respectively. The list of pilot firms is downloaded from: https://www.sec.gov/spotlight/shopilot/currentpilota41305.txt.

exhibits a significantly diminished effect for treatment firms and whether the influence of the pilot program is more pronounced for NIG bonds. Interestingly, even though the exemption and restriction are on stock markets, the bond short sell markets showed similar trends in regression. The results are shown in Table 8.

The findings indicate that throughout the duration of the pilot program's effectiveness, bond short interest (SIR) remains a robust predictor for yield spreads, even after accounting for stock short interest (SIR Stock in column (3)). However, since the policy primarily targets stocks, the negative relationship between bond short interest and future bond yield spreads would be driven by indirect, spillover effects rather than direct causal changes in the bond market. While the bond short interest may exhibit predictive power for future yield spreads after the policy change, the causal interpretation is complicated by the fact that the original intervention was on the stock market, not directly on the bond market. The strong correlation between stock and bond short interest suggests that bond short interest in this case is a proxy for overall market sentiment or firm-specific risks, rather than a standalone causal factor for changes in bond yield spreads.

Therefore, the observed effects in the bond market are not a pure test of bond short interest causality but rather a reflection of cross-market dynamics where stock market conditions influence bond prices and yields. This result is also consistent with the theory where a possible information transmission from the bond market to the stock market, as mentioned by Hendershott (2020). And effectiveness of the loosen policy is more significant among NIG bonds, which can be traced from column (4) with a negative coefficient -0.037 on interaction term SIR:NIG:Pilot.

In terms of the negative predictive power of bond short interest for future bond yield spreads following the relaxation of stock short-sale constraints, it could be interpreted primarily as

market efficiency improvements: By relaxing short-sale constraints on stocks, the market allows more information to be incorporated into stock prices and, by extension, bond prices. If investors anticipate negative credit outcomes for a firm (reflected in stock short interest), this expectation will also show up in the bond market, pushing bond yields higher as credit risk rises; Also, with fewer restrictions on short selling, investors can engage in more credit arbitrage, driving a closer relationship between stock short interest and bond pricing. Bond short interest, therefore, becomes a clearer predictor of future yield spreads as market participants actively trade both markets based on their expectations for the firm's future prospects.

In summary, although the empirical example cannot be regarded as a pure causality test for bond short interest because the policy change was targeted at stocks, the strong negative effects of bond SIR on bonds future yield spreads can be interpreted as arising from cross-asset information transfer, where changes in stock short interest and the relaxation of constraints lead to a reassessment of credit risk in the bond market. This illustrates how stock market interventions can influence the bond market through credit risk repricing and arbitrage dynamics, but it complicates the ability to isolate bond short interest as a standalone causal factor. This predictability is particularly pronounced when companies face heightened short-sale constraints, with a more substantial impact observed for non-investment-grade (NIG) bonds.

3.2.7 The effect of short interest during the financial crisis:

During the subprime crisis, a significant scarcity of arbitrage capital emerged, particularly evident around the period of Lehman's collapse. This shortage of capital-imposed constraints on short selling across the board. Consequently, it created a favorable scenario for an exogenous

shock, which can effectively address the issue of endogeneity. As the crisis intensified and added further hurdles to credit markets, this study aims to empirically verify the positive correlation between bond short interest and yield spread under conditions of heightened short-sale constraints during the crisis.

Specifically, we investigate whether the predictability of yield spreads by short interest is stronger during the subprime crisis, particularly when market-wide short-sale constraints are elevated. we also incorporate a dummy variable D into the regression model to account for the impact of capital strains during periods of market turmoil. To circumvent potential issues with multicollinearity in the Fama-MacBeth regression, given the correlation between the regressions on the monthly average return and the time dummy D signifying subprime crisis periods, a corporation fixed-effect model with standard errors clustered at the bond level is utilized. The regression results are showed in Table 9.

The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bond short interest (SIR) and its interaction with financial crisis period indicator D, which equals 1 between June 2008 to December 2008 and 0, otherwise. Bond controls include bond size, coupon, Amihud and rating. The model estimates the relationship between the dependent variable yield_spread_lead and the independent variables SIR, i.t, TMT, mamihud, and COUPON, while controlling for fixed effects at the level of companies (company_symbol). Additionally, it accounts for potential clustering of errors within groups defined by CUSIP. This approach helps to mitigate potential biases arising from unobserved heterogeneity at the company level and potential correlation of errors within groups.

In column 1, the results from the full sample demonstrate a notably elevated predictive capability of bond short interest during periods of market stress. Upon dividing the sample into investment-

grade (IG) and non-investment-grade (NIG) bonds in subsequent columns, a more pronounced effect is observed for NIG bonds. Moreover, stronger capital constraints during the subprime crisis show a greater influence on the predictability of yield spreads for distressed bonds. Therefore, we can confirm that the increased capital constraints during the subprime crisis have a more significant effect on the predictability of yield spreads for distressed bonds.

3.2.8 Bond short interest and bond rating downgrades

The previous findings suggest that bond short interest provides valuable insights into future yield spreads, with the strength of this signal increasing under greater short-sale constraints. Additionally, yield spreads are closely linked to a firm's credit standing, as higher spreads indicate worsening fundamentals and heightened default risk. Consequently, bond short interest should serve as a signal of poor future firm performance and elevated default risk. Firms with higher bond short interest are more likely to face downgrades, and this predictive relationship becomes stronger when short-sale constraints are more restrictive. To test this hypothesis, we conduct the following logistic regression:

$$Downgrade_{i,t} = \alpha + \beta_1 SIR_{i,t-1} + \beta_2 SIR_{i,t-1} * D_{i,t-1} + \beta_B B_{i,t-1} + u_{it} \qquad (7)$$

In this context, $Downgrade_{i,t}$ is a dummy variable that equals 1 if bond i's rating is downgraded in month t, and 0 otherwise. A positive $\beta 1 > 0$ suggests that bond short interest predicts rating downgrades. Additionally, a significantly positive coefficient for the interaction term $\beta 2>0$ would support the hypothesis that firms are more likely to experience downgrades when short-sale constraints are high.

Table 5 presents the results of the logistic regressions. In the univariate regression, the coefficient for the Short Interest Ratio (SIR) is positive and highly significant, indicating that a rising SIR predicts a higher probability of bond downgrades. Specifically, a one-standard-deviation increase in SIR raises the probability of a downgrade by approximately 21%, which is economically significant, indicating that bond short interest has a strong predictive power for bond downgrades.

When incorporating the interaction of SIR with utilization rates (DCBS) and the SIR/IO ratio, the coefficients of these interaction terms are also positive. The significantly positive interaction between SIR and utilization rates suggests that bonds are more likely to be downgraded when utilization rates, DCBS costs, and the SIR/IO ratio are high. These results support the hypothesis that bond short interest provides more informative signals about a firm's future credit risk when short-sale constraints are elevated.

3.2.9 Yield spread predictability excluding the downgrade periods

The results indicate that an increase in bond short interest predicts rating downgrades, and that yield spread predictability is much stronger for bonds with lower credit ratings. This raises the question of whether the observed predictability is primarily driven by rating downgrade events. To address this concern, we exclude observations from six months before and after a downgrade. Panel A of Table 11 presents the results from portfolio sorts, showing that all long-short spreads decrease after excluding these observations, with the decline being more pronounced for non-investment-grade (NIG) bonds. These findings suggest that a substantial portion of the predictive power of short interest is tied to rating downgrades, as the results in Table 11 show smaller absolute values compared to Table 2. However, the results also demonstrate that this

predictability extends beyond downgrade events, as the P-values for all P5-P1 portfolios remain significant even after excluding the downgrade data.

3.3.0 Differential effects of rating downgrades on IG and NIG bond spreads

We further control for the effect of rating downgrades on yield spreads using regression analysis. To capture the impact of downgrades on investment-grade (IG) and non-investment-grade (NIG) bonds, we construct three dummy variables. DIG is a dummy variable equal to one from six months before to six months after a downgrade for investment-grade bonds, and DNIG captures the same window for non-investment-grade bonds. DALL combines all downgrade windows, regardless of rating category. Panel B of Table 11 presents the results, showing that downgrades have a significant impact on yield spreads, with a much stronger effect on NIG bonds. The coefficients for DIG and DNIG are 0.003 and 0.034, respectively.

Importantly, the coefficients for SIR*NIG are highly significant, indicating that the predictive power of short interest remains substantially stronger for NIG bonds. Moreover, even when the DALL dummy is added to the model, the coefficient on SIR still demonstrates strong predictive power for future yield spreads. This suggests that rating downgrades do not fully account for the ability of short interest to predict future yield spreads, and this pronounced effect of short interest on the yield spreads of NIG bonds cannot be explained solely by rating downgrades.

4. Conclusion:

In summary, this paper employs both portfolio-sorting and regression methods to analyze the relationship between bond short selling and bond future returns, considering the influence of

stock short selling and bond characteristics. The key findings suggest a positive association between bond short selling and bond future returns, with the predictive power of short interest being more pronounced under high short sale constraints. Furthermore, both IG and NIG bonds exhibit positive predictive power for future yield returns, with NIG bonds showing significantly stronger predictability under high short sale constraints compared to IG bonds. The study also underscores the suitability of bond yield spread as a reliable proxy for bond future expected returns, evidenced by consistent results compared to the baseline model when employing the difference in maturity adjusted yield spread as the dependent variable. Additionally, the paper concludes that short-sale constraints impeding traders from shorting contribute to a reduced adjustment speed of bond prices to private information, this suggests that constraints on short selling in the bond market impede the flow of private negative information from bond short sellers into the corporate bond markets.

The paper also conducts special test for the sources of the short interest predictive power, finding out that short interest proves to be a stronger predictor for companies encountering increased challenges in arbitrage, information imbalances, and uncertainty. Additionally, the paper conducts further tests on the information spillover effect of the predictive power of bond SIR (Short Interest Ratio) using the Regulation SHO pilot program, which is usually considered as a causality test in stock market. These tests reveal a significant and resilient negative correlation between bond SIR and future yield spread when severe financial conditions are alleviated, which provide further insights into the transmission of signals from short sellers to bond markets, considering that yield spreads are heavily influenced by firms' creditworthiness: heightened spreads signify a deterioration in firms' fundamentals and an escalation in the risk of default. Lastly, the paper delves into the impact of short interest amid the subprime crisis, illustrating that

the heightened capital constraints during this period exert a greater influence on the predictability of yield spreads for distressed bonds.

Finally, integrating more examinations on bond downgrading concludes that the results show that rising bond short interest predicts rating downgrades, with yield spread predictability being more pronounced for bonds with lower credit ratings. However, the predictability remains significant even after accounting for the impact of rating downgrade events.

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Short-selling activity in the stock market the effects on small companies and the need for regulation: hearings before the Commerce, Consumer, and Monetary Affairs Subcommittee of the Committee on Government Operations, House of Representatives, One Hundred First Congress, first session, November 28, 29, and December 6, 1989. (1991). U.S. G.P.O

Table 1. Summary Statistics

Table 1 reports the summary statistics of the main variables. The sample period runs from July 2006 through September 2019. All variables are defined in Appendix A. Panel A reports the monthly mean, median, standard deviation, and the first and third quartiles (P25 and P75) of variables. Panel B reports pairwise correlations between key variables.

Panel A: Summary statistics of variables

Variable	N	Mean	Median	Std. Dev	P25	P75
YS (%)	454633	2.50	1.61	3.96	0.93	2.80
SIR	454633	0.02	0.01	0.03	0.00	0.02
SIR Stock	454633	0.04	0.02	0.05	0.01	0.04
SIR/IO	454633	0.05	0.01	1.62	0.00	0.04
Utilization	454633	0.07	0.02	0.12	0.01	0.07
DCBS	454633	1.07	1.00	0.36	1.00	1.00
Time to Maturity	454633	9.78	6.34	9.27	3.68	9.90
Bond Age	454633	4.15	3.08	3.94	1.50	5.67
Coupon	454633	5.57	5.75	2.12	4.20	7.00
Bond Size	454633	13.24	13.12	0.69	12.77	13.71
Illiquidity	454633	0.02	0.01	0.07	0.00	0.02
Callable	454633	0.84	1.00	0.37	1.00	1.00
Rating	454633	8.42	8.00	3.38	6.00	10.00

Panel B: Correlation matrix of key variables

	YS	*SIR*	*SIR Stock*	*Utilization*	*DCBS*	*SIR/IO*
YS	1.00					
SIR	0.14	1.00				
SIR Stock	0.42	0.23	1.00			
Utilization	0.25	0.77	0.33	1.00		
DCBS	0.31	0.19	0.29	0.37	1.00	
SIR/IO	0.06	0.05	0.01	0.06	0.05	1.00

Table 2.1: Yield Spreads and Issuers' Short Interest

This table presents the results of the portfolio analysis. For each month, we form quintile portfolios based on the previous month's bond short interest ratio (*SIR*). The P-value measure the significance of the difference in yield spreads between P5 and P1 (P5-P1). The sample period is from July 2006 to September 2019.

Panel A: Sorted by broad rating category														
	Value-weighted							Equal-weighted						
	P1	P2	P3	P4	P5	P5-P1	P-VALUE	P1	P2	P3	P4	P5	P5-P1	P-VALUE
ALL	2.18	2.11	2.17	2.32	3.22	1.04	1.18E-52	2.38	2.32	2.43	2.63	3.61	1.23	1.23E-55
AAA/AA	1.01	1.03	1.07	1.10	1.18	0.17	4.62E-09	1.04	0.98	1.00	1.03	1.14	0.1	4.78E-05
A	1.47	1.44	1.46	1.52	1.64	0.17	1.13E-13	1.48	1.39	1.40	1.46	1.56	0.08	6.12E-09
BBB	2.11	2.07	2.11	2.16	2.36	0.25	8.41E-18	2.17	2.11	2.11	2.18	2.35	0.18	4.49E-15
BB-D	5.64	5.49	5.60	5.95	7.05	1.41	3.23E-18	5.78	5.52	5.56	6.03	6.95	1.17	2.66E-20
IG	1.71	1.61	1.61	1.65	1.81	0.10	4.53E-03	1.79	1.67	1.64	1.68	1.86	0.07	1.60E-03
NIG	5.94	5.87	5.76	6.04	7.11	1.17	2.46E-10	5.94	5.70	5.67	6.10	7.00	1.06	7.21E-16

Table 2.2: Yield Spreads and Issuers' Short Interest under Bond Short Sale Constraint

This table presents the results of the bivariate portfolio analysis. For each month, we first sort bonds into SIR quintiles at time t-1, and then within each group we divide bonds into halves based on the previous month's short sale constraints measured by Utilization and dcbs, and SIR/IO and report value-weighted and equal-weighted yield spreads for these portfolios at time t. The P-value measure the significance of the difference in yield spreads between P5 and P1. The sample period is from July 2006 to September 2019.

Panel B: Sorted by Utilization and SIR														
	Value-weighted							Equal-weighted						
Utilization	P1	P2	P3	P4	P5	P5-P1	P-VALUE	P1	P2	P3	P4	P5	P5-P1	P-VALUE
All														
Low	2.14	2.13	2.16	2.20	2.51	0.37	1.90E-17	2.28	2.24	2.26	2.34	2.70	0.42	1.89E-24
High	2.20	2.11	2.20	2.50	4.14	1.94	1.41E-48	2.46	2.41	2.61	2.95	4.62	2.16	6.52E-51
IG														
Low	1.78	1.75	1.78	1.81	1.85	0.07	5.53E-02	1.83	1.75	1.75	1.79	1.84	0.01	4.85E-01
High	1.62	1.47	1.46	1.51	1.79	0.17	4.05E-05	1.72	1.56	1.53	1.58	1.90	0.18	4.40E-11
NIG														
Low	5.41	5.20	4.92	4.88	5.97	0.56	8.73E-06	5.54	5.02	4.84	4.89	5.82	0.28	1.39E-03
High	6.52	6.49	6.77	7.44	8.54	2.02	6.34E-10	6.36	6.37	6.54	7.36	8.28	1.92	2.43E-21

Panel C: Sorted by dcbs and SIR														
	Value-weighted							Equal-weighted						
dcbs	P1	P2	P3	P4	P5	P5-P1	P-VALUE	P1	P2	P3	P4	P5	P5-P1	P-VALUE
All														
Low	2.11	2.07	2.14	2.32	2.87	0.76	9.68E-30	2.28	2.18	2.29	2.48	3.11	0.83	1.29E-49
High	2.24	2.18	2.23	2.41	3.84	1.60	6.50E-48	2.47	2.45	2.59	2.85	4.29	1.82	6.88E-45
IG														
Low	1.66	1.58	1.60	1.64	1.79	0.13	9.70E-04	1.71	1.59	1.58	1.62	1.80	0.09	1.69E-02
High	1.73	1.64	1.64	1.69	1.87	0.14	1.73E-05	1.82	1.72	1.70	1.76	1.97	0.15	2.75E-13
NIG														
Low	5.43	5.41	5.45	5.52	6.11	0.68	7.46E-10	5.52	5.22	5.17	5.32	5.91	0.39	4.69E-07
High	6.71	6.40	6.25	6.82	8.43	1.72	1.34E-6	6.40	6.19	6.26	7.04	8.23	1.83	1.08E-14

Panel D: Sorted by SIRIO and SIR														
	Value-weighted							Equal-weighted						
SIRIO	P1	P2	P3	P4	P5	P5-P1	P-VALUE	P1	P2	P3	P4	P5	P5-P1	P-VALUE
All														
Low	2.16	2.15	2.27	2.40	2.90	0.74	4.26E-38	2.28	2.20	2.33	2.51	3.04	0.76	4.78E-38
High	2.16	2.10	2.12	2.34	3.76	1.60	2.67E-66	2.45	2.44	2.55	2.86	4.45	2.00	2.73E-67
IG														
Low	1.77	1.71	1.71	1.75	1.83	0.06	2.71E-02	1.81	1.73	1.71	1.75	1.83	0.02	2.31E-01
High	1.62	1.54	1.55	1.61	1.85	0.23	2.03E-08	1.70	1.57	1.57	1.63	1.94	0.24	3.31E-14
NIG														
Low	5.55	5.33	5.12	5.32	6.17	0.62	4.70E-06	5.61	5.14	4.97	5.23	6.08	0.47	7.24E-06
High	6.43	6.51	6.73	7.08	8.44	2.01	2.50E-17	6.31	6.29	6.52	7.20	8.14	1.83	3.94E-18

Table 3: Fama-MacBeth Cross-Sectional Regressions with Bond Constraint

This table reports the time-series averages of monthly cross-sectional Fama-MacBeth regressions. The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bonds short interest (SIR) and its interaction with various variables: NIG is the non-investment-grade dummy; D_u is a dummy variable, which equals 1 if the utilization ratio is greater than the 3rd quartile of the distribution and 0 otherwise; D_d equals 1 if dcbs is higher than 2 and 0 otherwise, D_i equals 1 if SIR/IO is greater than the 3rd quartile of the distribution and 0 otherwise. Bond controls include bond size, maturity, age, coupon, Amihud illiquidity, callable dummy, and rating. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019. Standard errors are listed in the bracket.

	(1)	(2)	(3)	(4)	(5)	(6)
SIR	0.069***	0.018***	0.07***	-0.088***	-0.019***	-0.151***
	(0.003)	(0.003)	(0.002)	(0.011)	(0.004)	(0.014)
$SIR * NIG$			0.022***			
			(0.008)			
$SIR * D_u$				0.105***		
				(0.009)		
$SIR * D_d$					0.127***	
					(0.008)	
$SIR * D_i$						0.165***
						(0.013)
SIR Stock	0.327***	0.162***	0.161***	0.161***	0.156***	0.161***
	(0.017)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)
Bond Controls	No	Yes	Yes	Yes	Yes	Yes
Ave. R-squared	0.314	0.493	0.495	0.494	0.497	0.494

Note: ∗p<0.1; ∗∗p<0.05; ∗∗∗p<0.01

Table 4: Sub–sample Test for IG and NIG Bonds

This table reports the sub-sample time-series averages of monthly cross-sectional Fama-MacBeth regressions. The 'IG' represent the dataset where all the bonds are investment grade bond; The 'NIG' represent the dataset where all the bonds are non-investment grade bond; The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bonds short interest (SIR) and its interaction with various variables: NIG is the non-investment-grade dummy; D_u is a dummy variable, which equals 1 if the utilization ratio is greater than the 3rd quartile of the distribution and 0 otherwise; D_d equals 1 if dcbs is higher than 2 and 0 otherwise, D_i equals 1 if SIR/IO is greater than the 3rd quartile of the distribution and 0 otherwise. Bond controls include bond size, maturity, age, coupon, Amihud illiquidity, callable dummy, and rating. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019. Standard errors are listed in the bracket.

	IG	NIG	IG	NIG	IG	NIG	IG	NIG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SIR	0.021***	0.022***	0.006**	-0.126***	0.017***	-0.009***	0.003	-0.130***
	(0.002)	(0.003)	(0.003)	(0.012)	(0.002)	(0.003)	(0.005)	(0.012)
$SIR * D_u$			0.015***	0.144***				
			(0.002)	(0.012)				
$SIR * D_d$					0.107*	0.063***		
					(0.062)	(0.006)		
$SIR * D_i$							0.017***	0.148***
							(0.004)	(0.011)
SIR Stock	0.072***	0.076***	0.072***	0.075***	0.071***	0.074***	0.072***	0.075***
	(0.006)	(0.004)	(0.006)	(0.004)	(0.006)	(0.004)	(0.006)	(0.004)
Bond Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ave. R-squared	0.705	0.677	0.705	0.678	0.706	0.680	0.705	0.678

Note: $*p<0.1$; $**p<0.05$; $***p<0.01$

Table 5.1 Fama-MacBeth Regression of SIR on Changes in Yield Spreads

Table 5.1 reports time-series averages of monthly cross-sectional Fama-MacBeth regressions. The 'IG' represent the dataset where all the bonds are investment grade bond; The 'NIG' represent the dataset where all the bonds are non-investment grade bond; The dependent variable is future yield spreads changes. The main independent variables are issuers' bond short interest (SIR). Bond controls include maturity, coupon and Amihud illiquidity. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019.

	ALL	IG	NIG
	(1)	(3)	(4)
SIR	0.240**	0.033	0.499***
	(0.112)	(0.093)	(2.60)
$SIR\ Stock$	0.858**	0.248	1.049**
	(0.396)	(0.227)	(0.444)
Bond Controls	Yes	Yes	Yes
Ave. R-squared	0.217	0.259	0.254
Note:			∗p<0.1; ∗∗p<0.05; ∗∗∗p<0.01

Table 5.2 Panel Regression of SIR on Changes in Yield Spreads

Table 5.2 specifies a fixed effects panel data regression model, where both time and month fixed effects are controlled. The 'IG' represent the dataset where all the bonds are investment grade bond; The 'NIG' represent the dataset where all the bonds are non-investment grade bond; The dependent variable is future yield spreads changes. The main independent variables are issuers' bond short interest (SIR). The sample period is from July 2006 to September 2019.

	ALL	IG	NIG	ALL	ALL	ALL
	(1)	(2)	(3)	(4)	(5)	(6)
SIR	0.200***	0.028	0.521***	-0.833***	-0.071	-0.763***
	(0.054)	(0.031)	(0.162)	(0.204)	(0.062)	(0.227)
$SIR * D_u$				1.033***		
				(0.197)		
$SIR * D_d$					0.981***	
					(0.108)	
$SIR * D_i$						0.950***
						(0.217)
$SIR\ Stock$	1.456***	0.221***	1.672***	1.444***	1.403***	1.452***
	(0.034)	(0.030)	(0.091)	(0.034)	(0.034)	(0.034)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.009	0.007	0.011	0.009	0.009	0.009
Note:						∗p<0.1; ∗∗p<0.05; ∗∗∗p<0.01

Table 6. Short-Term Dynamics of Yield Spreads

This table reports the parameter estimates of the partial adjustment model:

$$YS_{i,t} - YS_{i,t-1} = \beta_0 - \lambda YS_{i,t-1} + \lambda^{-} D * YS_{i,t-1} + \beta_2 TDQ_{i,t} + \sum_j \gamma_j Z_{i,j,t} + u_{i,t}$$

Bond yield spread changes are regressed against the lagged yield spread, the interaction with dummy variables of the short-sale constraint, and Markit's short interest (TDQ) using the daily Fama-MacBeth cross-sectional regression. In all the regressions, the bond characteristics (bond size, maturity, age, coupon, and rating), and firm characteristics (firm size, book-to-market ratio, net profit margin, idiosyncratic volatility, and leverage) are controlled. The Standard Error are in parentheses.

	Utilization	*DCBS*	*IO*
YS_{t-1}	-0.219***	-0.243***	-0.202***
	(0.025)	(0.025)	(0.025)
$YS_{t-1} * D_u$	0.038***		
	(0.010)		
$YS_{t-1} * D_d$		0.124***	
		(0.015)	
$YS_{t-1} * D_i$			0.030**
			(0.012)
Bond/Firm Controls	Yes	Yes	Yes
Ave. R-squared	0.591	0.609	0.598

Note: ∗p<0.1; ∗∗p<0.05; ∗∗∗p<0.01

Table 7.1. Short Interest Predictability and Firm Characteristics

This table reports the time-series averages of monthly cross-sectional Fama-MacBeth regressions. The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bond short interest (SIR) and its interaction with dummy variable Dx. We consider leverage ratio (Leverage), net profit margin (Profitability), dispersion in analysts' forecasts (Dispersion), number of analysts following (Coverage), market capitalization (Size), idiosyncratic volatility (IVOL), and bond Amihud illiquidity (Illiquidity). Dx takes a value of one if Leverage, Dispersion, IVOL, and Illiquidity are above their cross-sectional median values. For Profitability, Coverage and Size, Dx takes a value of one if they are below their cross-sectional median values. Bond controls include bond size, maturity, age, coupon, Amihud illiquidity, callable dummy, and rating. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019.

	Leverage	*Profitability*	*Dispersion*	*Coverage*	*Size*	*IVOL*	*Illiquidity*
SIR	0.032***	0.035***	-0.004	0.022***	0.019***	0.022***	0.050***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)
$SIR * D_X$	0.032***	0.023***	0.079***	0.050***	0.044***	0.040***	-0.004
	(0.004)	(0.005)	(0.006)	(0.005)	(0.004)	(0.004)	(0.005)
Bond Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ave. R-squared	0.471	0.471	0.473	0.471	0.471	0.471	0.471

Table 7.2. Short Interest Predictability and Firm Characteristics for NIG Bonds

	Leverage	*Profitability*	*Dispersion*	*Coverage*	*Size*	*IVOL*	*Illiquidity*
SIR	0.028***	0.030***	-0.009**	0.018***	0.012***	0.016***	0.051***
	(0.003)	(8.55)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)
$SIR * D_X$	-0.016***	-0.029***	0.034***	-0.014***	-0.014***	-0.001	-0.071***
	(0.004)	(0.009)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
$SIR * D_X * NIG$	0.100***	0.119***	0.105***	0.133***	0.129***	0.094***	0.191***
	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.004)	(0.012)
Bond Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ave. R-squared	0.474	0.475	0.476	0.474	0.475	0.474	0.475

Note: $*p<0.1$; $**p<0.05$; $***p<0.01$

Table 8. Causal Evidence from the Regulation SHO Pilot Program

This table reports the time-series averages of monthly cross-sectional Fama-MacBeth regressions. The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bond short interest (SIR) and its interaction with various variables: NIG is the non-investment-grade dummy, Pilot equals 1 if the issuer is included in the Regulation SHO pilot program and 0 otherwise. Bond controls include bond size, maturity, age, coupon, Amihud illiquidity, NIG, callable dummy, and rating. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019.

	(1)	(2)	(3)	(4)
SIR	0.027***	0.018***	0.034***	0.018***
	(0.002)	(0.002)	(0.003)	(0.002)
$SIR * NIG$		0.025***		0.033***
		(0.006)		(0.007)
$SIR * Pilot$			-0.017***	
			(0.006)	
$SIR * NIG * Pilot$				-0.037***
				(0.015)
$SIR\ Stock$	14.846***	14.760***	14.807***	14.692***
	(1.193)	(1.197)	(1.193)	(1.199)
Bond Controls	Yes	Yes	Yes	Yes
Ave. R-squared	0.534	0.535	0.535	0.537
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 9. Short Interest Effects in Times of Stress

This table reports the results of panel regressions. The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bond short interest (SIR) and its interaction with financial crisis period indicator D, which equals 1 between June 2008 to December 2008 and 0, otherwise. Bond controls include Amihud illiquidity, coupon, bond size and ratings. The standard errors are in parentheses are clustered at the bond level. The sample period is from July 2006 to September 2019.

	(1) Full sample	(1) Full sample	(2) IG	(2) IG	(3) NIG	(3) NIG
SIR	0.015**	0.003	0.022***	0.018***	-0.007	-0.028**
	(0.006)	(0.006)	(0.002)	(0.002)	(0.013)	(6.11)
$SIR * D$		0.186***		0.055***		0.302***
		(0.024)		(0.009)		(0.046)
Bond Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bond Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.490	0.491	0.462	0.463	0.439	0.42
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 10. Predicting Rating Downgrades

The table reports logit regression of future bond downgrades, where the dependent variable is a downgrade dummy. The downgrade dummy is measured in month t+1. The main independent variables are issuers' bond short interest (SIR) and its interaction with various variables. D_u is a dummy variable, which equals 1 if the utilization ratio is greater than the 3rd quartile of the distribution and 0 otherwise; D_d equals 1 if dcbs is higher than 2 and 0 otherwise, D_i equals 1 if SIR/IO is greater than the 3rd quartile of the distribution and 0 otherwise. Bond controls include bond size, maturity, age, coupon, Amihud illiquidity, and callable dummy. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019.

	(1)	(2)	(3)	(4)	(5)
SIR	5.996***	5.232***	-0.216	3.341***	0.302
	(0.261)	(0.276)	(1.587)	(0.397)	(1.699)
$SIR * D_u$			5.424***		
			(1.551)		
$SIR * D_d$				3.868***	
				(0.491)	
$SIR * D_i$					4.879***
					(1.658)
Bond Controls	No	Yes	Yes	Yes	Yes
Adjusted R-squared	0.007	0.020	0.020	0.021	0.020
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 11. Analysis Surrounding Downgrade Windows

Panel A presents the results of the portfolio analysis. For each downgraded bond, we exclude observations from six months before to six months after a downgrade. For each month, we form quintile portfolios based on the previous month's short interest ratio (*SIR*). The *P*-value measure the significance of the difference in yield spreads between P5 and P1 (P5-P1).

Panel A: Effects of short interest excluding the downgrade periods

	Value-weighted							Equal-weighted						
	P1	P2	P3	P4	P5	P5-P1	*P*	P1	P2	P3	P4	P5	P5-P1	*P*
All	2.01	1.92	1.98	2.12	2.68	0.82	6.70E-40	2.19	2.11	2.19	2.34	2.99	0.82	4.00E-62
AAA/AA	0.96	0.96	1.00	1.02	1.10	0.14	1.16E-06	0.99	0.92	0.94	0.96	1.06	0.07	1.06E-03
A	1.36	1.31	1.35	1.42	1.58	0.22	1.75E-32	1.40	1.31	1.32	1.39	1.52	0.12	1.31E-22
BBB	1.85	1.92	2.00	2.10	2.32	0.47	9.70E-57	2.08	2.03	2.04	2.10	2.26	0.18	4.11E-23
IG	1.64	1.53	1.54	1.58	1.73	0.09	3.68E-03	1.71	1.60	1.58	1.62	1.79	0.08	2.62E-04
NIG	5.22	4.86	4.84	4.94	5.53	0.31	3.60E-02	5.20	4.85	4.83	4.98	5.66	1.09	3.72E-07

Panel B: Cross-sectional regressions on *SIR* and downgrades

Panel B reports the time-series averages of monthly cross-sectional Fama-MacBeth regressions. The dependent variable is one-month-ahead bond yield spreads. The main independent variables are issuers' bond short interest (SIR) and its interaction with the non-investment-grade dummy (NIG). D_{IG} (D_{NIG}) is a dummy variable that takes the value of one from six months prior to six months after a downgrade for bonds with an investment-grade (non-investment-grade) rating. D_{ALL} is the combination of all the downgrade windows regardless of investment-grade or non-investment-grade. Bond controls include bond size, maturity, coupon, Amihud illiquidity, callable dummy, and rating. The Standard Error are in parentheses. The sample period is from July 2006 to September 2019.

	(1)	(2)	(3)	(4)	(5)
SIR	0.028***	0.018***	0.018***	0.014***	0.009***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
$SIR * NIG$				0.031***	0.030***
				(0.007)	(0.006)
D_{NIG}		0.034***	0.034***		
		(0.002)	(0.002)		
D_{IG}			0.003***		
			(0.0004)		
D_{ALL}					0.012***
					(0.001)
SIR Stock	0.157***	0.114***	0.112***	0.156***	0.136***
	(0.011)	(0.008)	(0.008)	(0.011)	(0.010)
Bond Controls	Yes	Yes	Yes	Yes	Yes
Ave. R-squared	0.524	0.569	0.571	0.525	0.543

Note: $*p<0.1$; $**p<0.05$; $***p<0.01$

Appendix

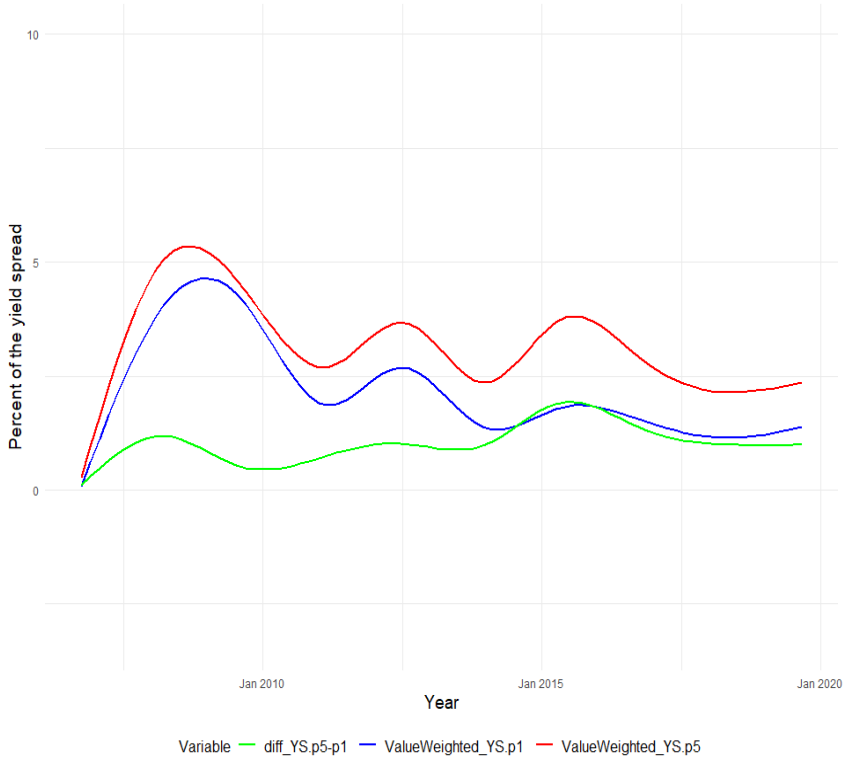
Table A1. Variable Definitions

Main	Description	Database
YS	The difference between yield to maturity on a corporate bond and yield to maturity on its duration equivalent Treasury.	TRACE
SIR	Total Demand Quantity of bond, measured by the ratio of the number of bonds on loan (from Markit) to the number of bonds outstanding (from FISD). We	Markit, FISD
SIR_Stock	Open stock short interest scaled by shares outstanding.	COMPUSTAT, CRSP
Utilization	The value of assets on loan from Markit lenders divides by the total lendable	Markit
DCBS	Daily cost of borrow score ranging from 1 for the lowest cost to 10 for the	Markit
SIR/IO	The ratio of short interest to the Institutional Ownership	EMAXX
Time to Maturity	Years to maturity of a bond.	TRACE, FISD
Bond Age	Number of years since bond issuance.	TRACE, FISD
Coupon	Coupon rate of the bond.	FISD
Bond Size	Log of the total amount of capital proceeds from bond issuance.	FISD
Illiquidity	$Illiquidity_{it} = \frac{1}{Days_{it}} \sum_{j=1}^{Days_{it}} \frac{\lvert r_{i,j,t} \rvert}{Vol_{i,j,t}}$, where $r_{i,j,t}$ is the return for bond *i* on day *j* of month *t*, $Vol_{i,j,t}$ is the trade size and $Days_{it}$ is the number of days for which transaction data are available for bond *i* in month *t*.	TRACE
Callable	Callable indicator.	FISD
Rating	An ordinal number ranging from 1 for AAA bonds to 20 for CC bonds.	FISD
NIG	A dummy variable that equals 1 if the bond is non-investment grade	FISD
Profitability	Net profit margin.	WRDS Financial
Leverage	Total debt scaled by book asset.	WRDS Financial
Dispersion	Analyst forecast dispersion, defined as standard deviation of earning forecast	I/B/E/S
Coverage	Number of analysts following the stock.	I/B/E/S
Size	Logarithm of market capitalization	CRSP
IVOL	Idiosyncratic volatility, defined as standard deviation of the monthly residuals relative to the Fama-French 3-factor model in the past 5 years	WRDS Beta Suite

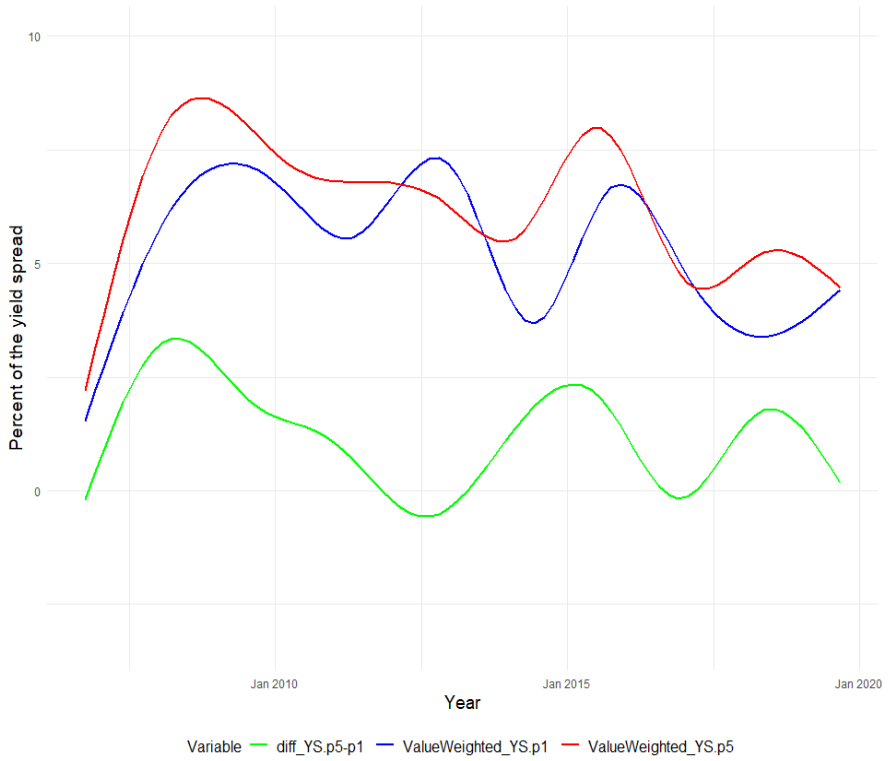
Figure 1. Yield Spread Difference between Portfolio 5 and Portfolio 1

The plots display the monthly differences in future bond yield spreads between portfolio 5 and portfolio 1, as shown in Table 2.1, for all bonds, NIG bonds, and IG bonds from July 2006 to September 2019. Panel A represents the full sample, while Panels B and C show the results for NIG bonds and IG bonds, respectively. The x-axis represents the timeline, and the y-axis shows the percentage difference in yield spreads. The red, blue, and green lines correspond to the yield spreads for portfolio 5, portfolio 1, and the percentage difference between the high and low portfolios, sorted by the previous month's short interest.

Panel A: Yield Spread Change with Year for All Bonds



Panel B: Yield Spread Change with Year for NIG Bonds



Panel C: Yield Spread Change with Year for IG Bonds

