Debt Refinancing and Corporate Bond Returns

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Abstract

This paper empirically examines how the maturity structure of financial leverage affects expected corporate bond returns, specifically through the rollover risk channel. We identify a strong positive effect of debt refinancing risk, as measured by refinancing intensity, on corporate bond excess returns in the subsequent year. Such an effect intensifies with heightened credit and liquidity risks, as well as during periods of constrained credit supply and elevated interest rates. Furthermore, we demonstrate that the premium associated with debt refinancing risk reflects higher exposure to credit risk and liquidity risk. Our study contributes to the literature by providing empirical evidence that the rollover risk of short-term debt is priced in the corporate bond market.

JEL Codes: G12; G3; G32

Keywords: Bond returns; Debt Refinancing; Rollover Risk; Financial Leverage

"Short-term gain, long-term pain? ... Just as that commercial paper needs to be rolled over, other sources of money – banks and the bond markets – aren't that hospitable."

— *The Wall Street Journal, Oct. 12, 2001*[1]

1 Introduction

The maturity structure of financial leverage becomes a high profile issue in corporate finance and asset pricing. Firms grappling with heightened refinancing risks may incur rollover losses when they issue new bonds to replace maturing bonds (He and Xiong, 2012). When refinancing, firms could face considerably higher costs due to shifts in market conditions or increased exposure to credit and liquidity risks (Brunnermeier and Pedersen, 2009; Acharya, Gale, and Yorulmazer, 2011; Cheng and Milbradt, 2012; He and Krishnamurthy, 2012).[2] Moreover, lenders might undervalue the firm's future potential and disallow refinancing, potentially resulting in an inefficient liquidation of the firm or fire sale of crucial assets (Diamond, 1991; Choi, Hackbarth, and Zechner, 2018). To mitigate the debt refinancing risk, firms tend to increase their cash holdings (Harford, Klasa, and Maxwell, 2014), reduce investment activities (Almeida, Campello, Laranjeira, and Weisbenner, 2011; Hong, Hou, and Nguyen, 2023) or engage in early debt refinancing (Xu, 2018). The aggregate outstanding amount of short-term debt, which matures within 1 to 3 years, has consistently shown an upward trajectory over the past two decades (refer to Figure 1), reaching $1.86 trillion in 2020.[3] Moreover, short-term debt accounts for approximately 35% of the total debt at the individual firm level.[4] As the Federal Reserve has taken a more aggressive approach in raising interest rates,[5] it has introduced a greater debt refinancing risk to U.S. firms. This prompts an intriguing question:

[1] "Firms Feel the Consequences of Short-Term Borrowing" by Henny Sender, October 12, 2001, *Wall Street Journal*, https://www.wsj.com/articles/SB1002810120972664880.

[2] This line of research has investigated various facets regarding the influence of market conditions on short-term debt. For example, Acharya et al. (2011) develop a model that elucidates the impact of market freeze on the rollover risk associated with short-term debt.

[3] The aggregate outstanding amount of short-term debt (maturing within 1 to 3 years) for publicly listed U.S. firms surged from $0.56 trillion in 2001 to $1.86 trillion in 2020, representing a threefold increase in the amount.

[4] This estimate is based on data from all publicly listed U.S. firms in Compustat for the year 2020.

[5] "Full recap of the Fed's rate hike and Powell's comments on the outlook for future increases", *CNBC*, September 21,2022, https://www.cnbc.com/2022/09/21/real-time-updates-of-the-federal-reserves-big-rate-decision-and-powells-press-conference.html.

How do investors perceive and respond to the heightened risks associated with the growing need to roll over short-term debt?

In this paper, we examine the impact of debt refinancing risk on expected bond returns. The potential outcome can be interpreted as differing perspectives regarding the benefits and costs of short-term debt. While Leland and Toft (1996) initially introduce the rollover losses mechanism, He and Xiong (2012)'s rollover risk channel highlights the *costs* associated with short-term debt. In particular, investors do not uniformly price risks linked to leverage; thus, a higher proportion of short-term leverage exposes investors to greater risks when renewing their maturing debt. As emphasized by He and Milbradt (2014), the rollover loss, which influences endogenous decisions about default, constitutes a significant ingredient in comprehending the default-liquidity interaction in the corporate bond markets. Building on He and Xiong (2012), recent work from Friewald et al. (2022) further underscores the significance of a firm's debt maturity structure to equity holders. Considering the potential for equity holders to absorb rollover losses, a firm's immediate requirement for debt refinancing is positively linked to the equity risk premium. As bonds and stocks represent claims on the same underlying assets of a firm, the equity risk premium could also manifest in the corporate bond market (Chordia, Goyal, Nozawa, Subrahmanyam, and Tong, 2017; Choi and Kim, 2018; Kelly, Palhares, and Pruitt, 2023).[6] Therefore, the immediacy of a company's debt refinancing needs may also result in higher risk premia for bond investors.

By contrast, another strain of literature pinpoints the *benefits* of short-term debt. The classical debt overhang problem outlined by Myers (1977) and Diamond and Rajan (2001) suggests that short-term debt may improve a firm's financial flexibility and mitigate agency conflicts, thus resulting in lower expected bond returns. Notably, Brockman, Martin, and Unlu (2010) demonstrate that short-term debt can curb executive compensation-related agency costs due to asset substitution, aligning with the theoretical prediction from Leland and Toft (1996) .

Given the two competing perspectives above, the impact of debt refinancing risks on bond pricing remains an open question, motivating us to investigate whether bond investors demand a

[6] Choi and Kim (2018) find that equity and corporate bond markets are integrated, but the risk premia of conventional factors tend to diverge across these markets. More recently, Kelly et al. (2023) find even higher levels of integration between debt and equity markets compared to previous findings in the literature.

premium for short-term debt compared to long-term debt. To do this, we examine the relationship between refinancing intensity, proxied by the ratio of short-term debt to total debt, and subsequent excess bond returns. Our principal result indicates that bondholders do not assign equal values to all types of leverage-related risks. After controlling for firm- and bond-level characteristics, an increase of one standard deviation in a firm's refinancing intensity is associated with a 0.32% annual increase in excess bond returns. This corresponds to approximately 6% of the average value of excess bond returns during the sample period. While bond returns increase with higher short-term leverage, no such effect is observed for long-term leverage. This is due to short-term leverage increasing a bond's exposure to dynamic rollover risk, resulting in higher risk premia. To summarize, we first provide preliminary evidence supporting the existence of debt maturity effects within the cross-section of bond returns. Secondly, we emphasize the significance of rollover risk rather than financial flexibility as a potential underlying mechanism.

After confirming the significance of the rollover risk channel, our study explores additional aspects specific to bond markets, considering their unique characteristics. An upward trend in short-term debt among U.S. firms potentially heightens the significance of both credit and liquidity risks (Custódio et al., 2013). This underscores the necessity of delving into the dynamics of the rollover risk channel, especially when intertwined with such risk factors. In response to these concerns, our paper empirically investigates the interaction of credit risks and liquidity risks with firms' refinancing intensity, and how these interactions further impact future bond returns.

First, we show that the impact of refinancing intensity on corporate bond returns is more significant for firms exposed to higher credit risks. After accounting for firm and bond-level characteristics, we find that high-yield bonds are more vulnerable to debt rollover risks, while high-quality bonds remain relatively immune. This phenomenon arises because low-rated firms may encounter difficulties in refinancing maturing debt within short time frames, particularly during periods of tight credit conditions or financial frictions. This aligns with Xu (2018)'s finding that speculative-grade firms tend to opt for early refinancing to mitigate rollover risk. These firms often issue new bonds with longer maturities to extend their maturity structures. Our results indicate that speculative-grade firms face heightened refinancing risks. This likely explains why these firms adjust their refinancing levels in a procyclical manner, possibly to mitigate potential risks, in contrast to investment-grade firms.

Next, we proceed to examine whether the positive premium linked to firms' debt refinancing intensity varies between liquid and illiquid bonds. Using the Amihud (2002) and Roll (1984) illiquidity measures as proxies for bond illiquidity, our findings demonstrate that the effect of debt refinancing intensity is stronger for illiquid bonds. The intuitive explanation is that, when companies with illiquid bonds need to refinance debt within a shortened time frame, they may have to offer better terms, such as higher yields, to attract bond investors.

We also examine whether the effect of debt refinancing intensity on bond returns varies across different bond maturities. We define short-maturity bonds as those maturing between one year and five years, while long-maturity bonds are often ten years or more. Our findings indicate a stronger debt refinancing intensity effect for bonds with longer maturity. Specifically, an increase of one standard deviation in refinancing intensity is linked to a 0.9% rise in annual risk premium for long-term bonds compared to short-term bonds. This suggests that bondholders may demand higher returns for long-term bonds issued by firms with a greater proportion of short-term debt, reflecting the higher refinancing risks associated with bonds with long-term maturity.

Subsequently, we conduct a comprehensive examination of the debt refinancing premium under various market conditions. Although default risk and liquidity risk premia are typically addressed as distinct concepts in the existing literature (Lin et al., 2011; Huang and Huang, 2012), it is not feasible to completely separate the two from bond risk premium. He and Xiong (2012) show that the decrease in debt market liquidity results in an increase in both liquidity premium and default premium, which makes it challenging to differentiate between liquidity risk and credit risk. Therefore, in such a context, these two types of risk are interdependent and cannot be analyzed in isolation. To illuminate how the interaction between the impact of exogenous credit supply shocks (as a proxy for both default and liquidity risks) and debt rollover risk affects excess bond returns, we utilize the 2007-2009 financial crisis as an excellent setting to examine the interrelated impact of credit risk and liquidity risk on the debt maturity structure, as well as their compounded effects in the corporate bond markets. Our results show that during times of crisis, investors typically demand higher risk premia, as indicated by elevated bond returns. This increased expectation is a direct consequence of exogenous liquidity shocks, such as financial crises, which create a need for a greater rollover risk premium in response to the perceived market instability and unpredictability (He and Krishnamurthy, 2012).

Moreover, there is anecdotal evidence indicating that firms often adapt their refinancing plans in response to significant increases in interest rates,[7] while Leland (1994) notes that changes in interest rates have a substantial impact on debt maturity structure sensitivity. We further examine the impact of an escalating interest rate environment on the rising costs of refinancing for firms aiming to replace current debt, which is associated with increased investor demand for higher risk premia. Our findings indicate that the debt refinancing effect becomes more pronounced when the interest rates are rising. Furthermore, in times of low investor sentiment or increased risk aversion, bond investors typically demand higher risk premia. To capture these market conditions, we employ two proxy measures: the risk aversion index (Bekaert, Engstrom, and Xu, 2022) and the issuer quality measure (Greenwood and Hanson, 2013). Our findings consistently demonstrate that investors demand higher premia for debt rollover risk during periods characterized by tight market conditions.

Finally, we employ factor-mimicking portfolio procedures, as outlined by Friewald et al. (2022), to quantify the premia associated with a firm's debt maturity structures and evaluate their relationship with systematic risk. Specifically, we run spanning tests using the well recognized bond risk factors documented in Fama and French (1993) and Lin et al. (2011). We first conduct a triple sort of bonds into portfolios based on their ratings, maturity, and associated debt maturity structure, which we proxy as refinancing intensity (RI). This sorting procedure allows us to disentangle premia associated with other common factors from those linked to debt refinancing intensity. In alignment with previous research (He and Xiong, 2012; Friewald et al., 2022), our study reveals a notable positive premium for debt refinancing risk. Our findings underscore the correlation between a greater immediacy of debt refinancing and increased bond returns. The positive loadings observed

[7] "Companies Hasten Debt Refinancing Plans Amidst Looming Higher Interest Rates, Says New Study" by Nina Trentmann, April 7, 2022, *Wall Street Journal*, https://www.wsj.com/articles/companies-may-speed-up-refinancing-plans-as-higher-rates-loom-11649336684.

in the spanning tests carry both statistical and economic significance, specifically in relation to the credit risk factor and the liquidity risk factor. These results are in line with our baseline findings.

Our research provides a distinctive perspective by examining the impact of financial leverage and maturity structure on expected bond returns, building on a well-established rollover risk model. One contribution of our paper is empirically validating the role of short-term debt in accelerating rollover risk, as evidenced by an increase in bond risk premia associated with the proportion of short-term debt, but not with total leverage as a whole. This finding holds significant implications for corporate finance, indicating the need for companies to consider refinancing risks when deciding debt maturity. When seeking external financing, firms should not only assess their overall level of debt but also the risk associated with the portion of short-term debt that requires more frequent rollovers. As per He and Xiong (2012), equity holders bear rollover losses, while maturing debt holders are paid in full. Expanding on this work, we find that beyond equity investors, bondholders also demand risk premia associated with the firm's short-term debt. Considering the evident increase in U.S. firms' propensity to use debt financing over the century (Graham, Leary, and Roberts, 2015), corporations may find it beneficial to thoughtfully evaluate how they can optimize their debt maturity structure.[8]

This study sheds new light on how the rollover risk of short-term debt is priced in the corporate bond markets. Previous research has emphasized that firms often utilize staggered short-term debt to finance high-risk, long-term, and illiquid assets, resulting in a freeze on rollovers during the financial crisis (Acharya et al., 2011). Due to uncertainty about the future state of the market, short-term creditors may be unwilling to renew their debt holdings. Consequently, short-term debt exposes firms to funding risks on the liability side (Brunnermeier, 2009). When both a risk-shifting problem and a coordination problem among creditors coexist, the utilization of very short-term debt can be deemed inefficient in terms of enhancing total firm value, primarily because it diminishes creditor confidence (Cheng and Milbradt, 2012). Our findings extend this line of reasoning by proposing that the risk of a rollover freeze may be passed on to the debt holders, leading bondholders to anticipate higher premia on short-term debt, potentially reflecting low creditor confidence and

[8] Greenwood, Hanson, and Stein (2015) examine whether the government should optimally determine the maturity structure of its debt.

high funding risks. In addition, our research is the first to demonstrate that, by using short-term leverage as an important proxy, corporate bond returns exhibit return predictability similar to that in equities (Friewald et al., 2022).[9]

This paper also contributes to the body of literature examining the implications of debt maturity, particularly focusing on the underlying risks of short-term debt. For example, Diamond (2004) posits that borrowing large amounts of short-term debt can result in the threat of runs on firms;[10] thus, refinancing risk and short-term debt are critical aspects of costly enforcement in financial markets. Diamond and He (2014) point out that short-term debt can result in premature business closures and liquidations for companies lacking external financing to fulfill debt obligations. Our study extends the current theoretical literature by empirically investigating the risk and return trade-off of short-term debt in corporate bond markets. We show how the urgency of debt refinancing influences the corresponding bond returns in the subsequent period.[11]

Finally, our paper adds to the line of research investigating the factors that determine corporate bond returns. Since the study by Gebhardt, Hvidkjaer, and Swaminathan (2005), more recent research has focused on testing various risk factors that determine expected corporate bond returns.[12] However, the impact of corporate factors on corporate bond pricing has been understudied (Huang and Shi, 2021). While our paper examines the interaction between refinancing intensity (RI) and bond risk factors, its objective is not to discover a new risk factor or to determine whether RI is a potential risk factor. Instead, we consider RI as a fundamental firm characteristic and explore whether debt refinancing risk is priced into corporate bonds. Our work is related to Baker, Greenwood, and Wurgler (2003), in which they demonstrate that the maturity of new debt issues predicts

[9] Valenzuela (2016) have examined the effect of rollover risk on credit spreads, demonstrating that a high proportion of short-term debt exacerbates the impact of debt market illiquidity on credit spreads. While our studies share a common theme, they diverge in their primary focus. Specifically, we place our primary emphasis on investigating the impact of debt refinancing on excess bond returns in the subsequent year.

[10] The firm run follows a similar logic as in the famous bank run models dating back to the study by Diamond and Dybvig (1983).

[11] In a contemporary study, Hong, Hou, and Nguyen (2023) employ similar models to examine how firms' debt maturity structure affects investment decisions, going beyond the impact of leverage. While their study emphasizes the significance of debt maturity structure in understanding corporate investment decisions, our focus lies specifically on the corporate bond markets.

[12] These studies, among others, include Collin-Dufresne, Goldstein, and Martin (2001), Eom, Helwege, and Huang (2004), Huang and Huang (2012), and Huang, Nozawa, and Shi (2022).

excess bond returns.[13] Differ from their work, we investigate the cross-sectional relationship between short-term debt and expected bond returns using individual-level bond data. In addition, we focus on the maturity structure of financial leverage of existing debt, contrasting with their focus on new debt issues.

The remainder of this paper is organized as follows. In Section 2, we provide the literature review and hypothesis development for our analysis. Section 3 explains the data and methodology, while Section 4 presents our main findings. We then delve into the discussion of debt refinancing under different market conditions in Section 5. In Section 6, we assess the risk premium associated with a firm's debt maturity structure. Section 7 concludes.

2 Related Literature and Hypothesis Development

2.1 Debt Maturity and Rollover Risk

The literature on theoretical corporate finance recognizes debt maturity choice as a significant component in the structural model of credit risk (Fischer and Cox, 1976; Leland, 1994). Recently, He and Xiong (2012) demonstrate how a firm's existing debt structure can affect its refinancing intensity. The role of debt maturity is crucial in determining a firm's rollover risk, which is compounded by short-term debt. Firms with a higher proportion of short-term debt are more likely to face greater rollover risk, resulting in a higher risk premia during refinancing.[14] Specifically, the rollover risk model suggests that, given the total leverage, equity risk increases with short-term leverage but decreases with long-term leverage.

Building on the work of He and Xiong (2012), Friewald et al. (2022) examine the cross-sectional relationship between leverage and equity returns with a focus on the effects of debt refinancing intensity. Their findings reveal that shareholders are more cautious about a firm's debt maturity structure and, therefore, demand a higher equity premium when short-term debt is involved. This

[13]In their paper, Baker et al. (2003) examine whether time series variation in the maturity of debt issues is tied to predictability in excess long-term bond return. They discover that higher proportions of long-term debt issuance relative to total debt issuance correspond to lower future bond returns.

[14]Chen, Xu, and Yang (2021) take a non-standard approach, different from Leland and Toft (1996) and He and Xiong (2012), to model firms that are not required to rollover matured debt immediately. Instead, firms are allowed to optimally adjust their capital structure when existing debt matures. With these caveats in mind, we indeed find direct evidence of the rollover risk premium, which bolsters the debt rollover mechanism.

aligns with the notion that a firm's immediacy for debt refinancing, measured by short-term leverage, exposes its equity to more systematic risk. This is commonly referred to as the *rollover risk* channel of short-term debt, suggesting that risk escalates with the short-term leverage.

In contrast, the concept of *financial flexibility* proposes that short-term debt can help reduce agency conflicts, especially those arising from debt overhang. Excessive long-term debt may cause shareholders to hold back investments in projects with positive net present value, as they expect the resulting profits will be used to repay existing debt holders. According to Myers (1977), firms can use short-term debt to minimize the costs of underinvestment and mitigate conflicts between bondholders and equity holders.[15] Meanwhile, Brockman, Martin, and Unlu (2010) show, from an executive compensation perspective, that short-term debt can mitigate agency costs of debt that arise from asset substitution,[16] which is consistent with Leland and Toft (1996)'s theoretical prediction.

The fundamental idea behind the *financial flexibility* channel is that short-term debt can discipline management, reduce moral hazard, and thus lower agency costs.[17] However, recent evidence challenges the traditional view and suggests that short-term debt may actually increase incentives for risk-taking, especially for firms facing financing frictions or constraints that limit their ability to make optimal default decisions. For instance, Della Seta, Morellec, and Zucchi (2020) develop a model demonstrating that short-term debt amplifies the effects of negative operating shocks, thereby increasing default risk and incentivizing risk-taking.

Building upon these two rationales, several studies have examined the impacts of debt rollover risk on various facets of firms, including their investment decisions (Almeida et al., 2011; Hong et al., 2023) and cash holdings (Harford et al., 2014). The study by Harford et al. (2014) shows that refinancing risk significantly influences a company's cash reserves, underscoring the interdependence of a firm's financial choices. In an examination of early refinancing risks in corporate bond markets,

[15]Nevertheless, a survey conducted by Graham and Harvey (2001) on companies' debt preference indicates limited support for the idea that short-term debt is utilized to mitigate underinvestment.

[16]In their seminal study, Jensen and Meckling (1976) note that shareholders are motivated to appropriate bondholders' wealth by shifting their investments to riskier options, which is commonly referred to as asset substitution.

[17]The idea that short-term debt can discipline management and reduce moral hazard was initially introduced by Barnea, Haugen, and Senbet (1980). Subsequent significant contributions to this literature include Calomiris and Kahn (1991), Leland (1998), Cheng and Milbradt (2012), and Huberman and Repullo (2014).

Xu (2018) scrutinizes how speculative-grade firms tactically navigate debt maturity by frequently engaging in early refinancing of corporate bonds to extend their maturity, especially during periods of accommodating credit supply conditions.

Different from the previous work, our paper addresses a distinct aspect of debt rollover risk by examining the following research question: What is the effect of debt refinancing intensity on corporate bond returns?

2.2 Corporate Bond Returns

For the past few decades, financial economists have employed various approaches to examine the factors that determine corporate bond returns. One strain of literature focuses on the cross-sectional analysis of corporate bond returns, specifically exploring the impact of risk factors in empirical research (Fama and French, 1993; Lin et al., 2011; Chung et al., 2019; Huynh and Xia, 2021). One takeaway from this literature is that several factors are essential to explain the cross-sectional variation in average bond returns, including common risk factors encompassing credit risk, liquidity risk, and market risk within the corporate bond market. However, as pointed out by Dickerson, Mueller, and Robotti (2023), previously proposed bond risk factors, with traded liquidity as the only marginal exception, do not possess any incremental explanatory power over the corporate bond market risk.

Following the spirit of Gebhardt et al. (2005), which emphasizes that beta (factor loading) is superior at predicting expected returns compared to firm characteristics, numerous studies over the last two decades have focused on searching for or applying various risk factors to explain corporate bond returns. Nonetheless, a potential shortcoming of relying solely on risk factors to determine asset prices is that if a particular firm characteristic can be fully explained by one or several of the distinct risk factors, this characteristic might appear inconsequential in explaining returns (Bessembinder, Cooper, and Zhang, 2019). Considering this perspective, the influence of corporate finance decisions on corporate bond returns has received limited attention. Yet, exploring the role of a firm's behavior in asset pricing, especially within the context of the corporate bond market, remains an important and unresolved issue.

As such, we investigate whether bondholders consider firms' debt maturity structure and, therefore, price leverage associated with short-term and long-term debt differently. To address this notion, we propose treating the main variable of interest in this study - refinancing intensity (RI) - as similar to capital structure, which is a key component of firm characteristics. Thus, by design, this study aims to bridge the rollover risk channel to bond pricing literature by testing the association between short-term debt and the excess returns of corporate bonds. That said, the purpose of this study is not to search for a new risk factor to explain expected bond returns, but rather to empirically test how short-term debt is priced in corporate bond markets and how such premium is connected with the existing bond risk factors. This methodology aligns with that of Friewald et al. (2022), shedding light on debt maturity structure implications on asset prices in the corporate finance literature.

Additionally, we investigate the significant components of risk premia that are widely believed to have substantial impacts on corporate bond returns. However, our study differs from prior research. For instance, Lin et al. (2011) concentrate on market-wide liquidity shocks and their influence on bond returns. In contrast, we extend our investigation to include market credit supply shocks in conjunction with liquidity shocks, addressing endogeneity concerns. Furthermore, we analyze the potential confounding impact of firm-level liquidity measures and refinancing risks on expected bond returns. We also explore the effect of refinancing risks under various market conditions, consistent with Acharya et al. (2013). They note that the impact of liquidity shocks on asset prices varies depending on the economic climate, with a more pronounced effect during adverse economic periods.

2.3 Main Hypothesis

This study explores the impact of rollover risk on excess bond returns, with a specific focus on investigating the implications of short-term debt in the U.S. corporate bond market. In a scenario where a firm has the option to issue new debt, it weighs the monetary premium linked to short-term debt with the refinancing risk stemming from the need to frequently rollover its debt. In this setting, the optimal debt maturity hinges on a straightforward trade-off. On the one hand, tilting the issuance towards shorter maturities provides greater financial flexibility, resulting in a lower expected financing cost. On the other hand, adopting a strategy of short-term financing exposes the firm to rollover risk, as future interest rates are unpredictable (Nosbusch, 2008; Greenwood, Hanson, and Stein, 2015). This rollover risk entails real costs by introducing instability in future financing. This trade-off predicts a diverged correlation between short-term leverage and the risk premium, as the proportion of short-term debt rises; the cost can either rise or fall through two distinct channels.

The first channel is the *rollover risk* channel, which is elaborated in theoretical models from He and Xiong (2012). Debt maturity plays a crucial role in determining a firm's rollover risk. This risk is exacerbated by the urgency of a company's debt refinancing obligations, quantifiable through metrics such as its refinancing intensity (RI) or short-term leverage. The risks associated with leverage are not all equally priced by investors, and thus, the returns on bonds are likely to increase as the fraction of a company's short-term debt relative to its total debt rises.

In this context, research by He and Milbradt (2014) indicates that endogenous debt maturity, which involves balancing rollover risk and liquidity risk, can influence liquidity risk premia on bonds. Firms issuing corporate bonds consider the liquidity risk premia as part of their debt cost. Consequently, liquidity risk can affect a firm's debt cost, leading to potential changes in its financing decisions and, ultimately, the bond risk premia. This result aligns with prior research on the debt rollover mechanism, including the studies by Cheng and Milbradt (2012) and Brunnermeier and Oehmke (2013).

As indicated by Friewald et al. (2022), shareholders care about firm's debt maturity structure as the rollover loss is absorbed by the firm's equity holders. Hereafter, a firm's need for debt refinancing is positively associated with the equity risk premium. As bonds and stocks both represent claims on a firm's underlying assets, the equity risk premium could also become evident within the corporate bond market (Chordia et al., 2017; Choi and Kim, 2018; Kelly et al., 2023). Similarly, the immediacy of a company's debt refinancing needs may also result in higher risk premia for bond investors. Firms with a higher proportion of short-term debt are more vulnerable to rollover risk, as they may struggle to refinance maturing debt within a short time frame, particularly during periods of tight credit conditions or market stress. Consequently, bondholders may require risk premia when investing in bonds issued by firms with higher rollover risk, which would result in an increase in bond returns. If the *rollover risk* channel dominates, corporate bond returns increase as the proportion of short-term debt (compared to total debt) increases, and hence the company's debt maturity choice has a positive impact on expected bond returns. Drawing from the *rollover risk* channel above, we derive the following empirical hypothesis:

H1a: There is a *positive* relation between debt refinancing intensity (RI) and corporate bond returns.

On the contrary, short-term debt can enhance a firm's financial flexibility, acting as a mechanism to discipline moral hazard (Jensen and Meckling, 1976). The second channel, *financial flexibility*, builds upon the classical debt overhang problem outlined by Myers (1977) and Diamond and Rajan (2001), proposing that short-term debt might alleviate agency conflicts like debt overhang and consequently enhance a company's financial flexibility. This, in turn, could mitigate risks linked to short-term leverage while concurrently intensifying risks associated with long-term leverage, ultimately leading to decreased anticipated bond returns. Therefore, we also advance the competing hypothesis based on the *financial flexibility* channel:

H1b: There is a *negative* relation between debt refinancing intensity (RI) and corporate bond returns.

3 Data, Sampling, and Key Variables

3.1 Data and Sample

The sample used in this study consists of leveraged, non-financial firms that are listed on the NYSE, NASDAQ, and AMEX from July 2002 to December 2020.[18] Our corporate bond sample is compiled from two major sources: (1) the enhanced version of Trade Reporting and Compliance Engine (TRACE) Enhanced database, which provides transaction data of all publicly traded corporate bonds in the U.S.; and (2) Mergent fixed income securities database (FISD), which contains information on bond issue and issuer characteristics. Following Dick-Nielsen (2014),

[18] We start the sample in 2002 as this coincides with the availability of data from the TRACE Enhanced database.

we clean the TRACE data by eliminating canceled, corrected, and reversed trades. We then merge TRACE with the Mergent FISD to obtain information on corporate bond issuers and issues, such as offering amount, offering date, maturity date, coupon rate, coupon type, interest payment frequency, bond type, and bond rating. Following Bessembinder et al. (2008), we further restrict our sample of corporate bonds to those listed and traded in the US public market, eliminating bonds that: i) are issued through private placement and under the 144A rule; ii) have maturity of less than one year and issue amount of less than $1 million; iii) are preferred shares, mortgage backed, asset backed, convertible and exchangeable as well as floating coupon rates; and iv) have missing information on coupon, rating, interest payment frequency, and bonds.

Accounting data are collected from the Compustat Annual and Quarterly Fundamental Files and stock returns are obtained from the Center for Research in Security Prices (CRSP). To ensure the accuracy of future return analyses, a six-month lag was incorporated when merging these data sets, as recommended by Fama and French (1992). This conservative approach ensures that the accounting data are known prior to their use in subsequent return analyses, potentially reducing the possibility of erroneous conclusions. In accordance with Cooper, Gulen, and Schill (2008) and Friewald et al. (2022), we eliminate financial firms (SIC codes 6000-6999) and companies with non-positive book equity. We also exclude firms with non-positive total assets and market equity. Since the purpose of the paper is to investigate the impact of debt maturity on bond returns, we require firms' leverage ratios to be non-zero. Specifically, we treat missing values of $dd1$ and $dltt$ as zero and set missing values of $dd2$ to $dd5$ to zero if at least one is non-missing.[19] Moreover, we enforce that all debt items ($dd1$ to $dd5$, $dltt$) must be non-negative. In addition, we implement two extra filters (Almeida et al., 2011). The first filter eliminates observations where the total debt ($dd1 + dltt$) exceeds the total assets, while the second filter eliminates observations where debt maturing in more than a year ($dltt$) is less than the sum of debt maturing in two, three, four, and five years ($dd2 + dd3 + dd4 + dd5$) from the balance sheet date.

The final sample consists of 296,864 observations on bond-months spanning from July 2002 to December 2020, covering 7,812 corporate bonds. On average, there are approximately 1,330 bond

[19] $dd1$ through $dd5$ refer to long-term debt due in the first through the fifth year, respectively. The variable $dltt$ represents long-term debt in total.

observations per month over the sample period.

3.2 Key Variables

In light of the steadily growing upward trajectory in the amount of corporate debt maturing in the near term, as demonstrated in Figure 1, we recognize that relying solely on the aggregate maturing debt may offer only preliminary insights into a firm's debt maturity structure. The size of a firm can lead to significant misleading effects; for instance, larger firms may possess a higher dollar amount of short-term debt but a relatively low short-term debt ratio compared to smaller firms. To gain a more accurate understanding, we delve deeper by decomposing a firm's leverage into two components: short-term leverage (debt maturing in the next three years) and long-term leverage (debt maturing after the next three years).

The focal point of this study is the debt refinancing intensity (RI). Consistent with Friewald et al. (2022), RI is defined as the ratio of short-term debt ($dd1 + dd2 + dd3$) to total debt ($dd1 + dltt$), as shown below:

$$RI = \frac{dd1 + dd2 + dd3}{dd1 + dltt} \tag{1}$$

Specifically, RI measures the proportion of long-term debt maturing in the next three years over total debt (i.e., the sum of short-term and long-term debt). Our study aligns with the research conducted by Harford et al. (2014), which focuses on debt instruments with an initial maturity exceeding one year. This choice is made because nonfinancial firms typically utilize debt with a maturity at issuance of less than one year to finance short-term, seasonal liquidity needs, while debt instruments with a maturity exceeding one year are used to finance long-term assets that will be required for rolling over when they come due. The estimation of the RI is conducted on an *annual* basis due to the limitation that data pertaining to long-term debt obligations mature from one year ($dd1$) to five years ($dd5$) is exclusively accessible within the Compustat annual files. The RI measure takes on high values when firms have a higher short-term leverage ratio and expose bondholders to debt rollover risk.

Following Öztekin and Flannery (2012) and Harford et al. (2014), we define the leverage ratio,

LEV, as the ratio of total short-term and long-term debt relative to total assets, as shown below:

$$LEV = \frac{dd1 + dltt}{AT} \tag{2}$$

This paper aims to investigate the impact of debt maturity, which requires to concentrate on observations where $LEV > 0$, as otherwise, RI cannot be determined. In our primary analyses, we use a sample that covers all levered firms (All-LEV). Consistent with Strebulaev and Yang (2013) and Friewald et al. (2022), we also perform analyses on a sample that excludes almost-zero-leverage (AZL) firms, defined as those with $LEV < 0.05$. By utilizing this All-but-AZL sample, we ensure that our findings concerning the impact of debt maturity on bond returns are not influenced by firms with minimal leverage.

Another key variable is bond returns. Following Lin et al. (2011), we calculate the monthly corporate bond return i at time t as:

$$r_{i,t} = \frac{P_{i,t} + AI_{i,t} + C_{i,t}}{P_{i,t-1} + AI_{i,t-1}} - 1 \tag{3}$$

where $P_{i,t}$ is defined as the transaction price, $AI_{i,t}$ as the accrued interest, and $C_{i,t}$ as the coupon payment, if applicable, for bond i in month t. Additionally, we represent bond i's excess return as $R_{i,t}$, where $R_{i,t} = r_{i,t} - r_{f,t}$ and $r_{f,t}$ is the risk-free rate approximated by the one-month Treasury bill rate.

3.3 Control Variables

To account for potential factors affecting bond returns, we incorporate a comprehensive list of bond-level and firm-level control variables. First, we include return on equity (ROE), which accounts for cross-sectional variations in issuers' cash flows and is calculated as income before extraordinary items divided by the book value of common equity. Second, we control for bond-specific characters such as bond maturity (in years), credit rating, and issue size. To convert letter ratings to a continuous numerical scale, we assign a score ranging from 1 (highest) to 22 (lowest), with AAA=1, AA+=2, AA=3, and so on down to C=21, and D=22. Ratings of 10 (BBB-)

and below are classified as investment grade, while ratings above 10 are non-investment grade. Additionally, we incorporate measures of corporate bond illiquidity (Illiquidity) using the Amihud (2002) measure and Roll (1984) measure and return reversal (Reversal), which is calculated as the bond's excess return in the previous month. Finally, we control for the presence of callable bonds using a dummy variable. The variable construction details are provided in Appendix.

3.4 Summary Statistics

Table 1 presents summary statistics of bond returns as well as firm and bond characteristics. To minimize the influence of extreme values, we winsorize all continuous variables at their 1st and 99th percentiles. The monthly excess bond return has a mean of 0.45% with a standard deviation of 3.64%. The 25th to 75th percentiles of excess returns spans from -0.47% to 1.32%. The distribution of excess bond return is similar to the findings reported in Huynh and Xia (2021).[20]

The average values of RI and LEV are 0.27 and 0.32, respectively, and the average ROE is 0.15. In our analysis, we limit our sample to leveraged, non-financial firms with corporate debt issues. In comparison to Friewald et al. (2022), our sample firms exhibit lower RI but have higher profitability.[21] The sample consists of bonds with a median rating of 7 (i.e., A-) and an average time-to-maturity of 10.46 years.[22] Our sample of bonds consists of issues from publicly listed firms, which have slightly higher credit ratings and longer time-to-maturity. The average bond issue size is \$0.65 billion and approximately 80% of the bonds included are callable bonds.[23]

We adopt the estimation methodology proposed by Merton (1974) and Bharath and Shumway (2008) to estimate the expected default frequency (EDF) of the bond issuers. The average of EDF is 0.02 with a standard deviation of 0.09. It is important to highlight that the majority of bond

[20] In Huynh and Xia (2021), the average monthly excess bond return is 0.50%, ranging from -0.52% to 1.49% between the 25th to 75th percentiles. It is worth noting that our sample covers a longer time span, including an additional six years compared to their study.

[21] In Friewald et al. (2022), the average RI is 0.40 with an average ROE of 0.011.

[22] The numerical credit rating of the bonds is determined using the following letter rating conversion scheme: AAA=1, AA+=2, ..., C=21, and D=2. Our primary source for credit ratings is the Standard & Poor's (S&P) ratings obtained from the Financial Information Services Division (FISD). In cases where S&P ratings are unavailable, we rely on Moody's or Fitch ratings if they are accessible. Bonds without identifiable ratings are excluded from our analysis.

[23] Our findings align with those of Huang, Qin, and Wang (forthcoming), where the average issue size is reported as \$0.63 billion, and around 75% of the bonds in their sample were issued with call options.

issuers exhibit relatively low expected default frequencies and more than 75% of the firms in our sample have an EDF of 0.01% or less. We employ two bond illiquidity measures. The first measure is the Amihud illiquidity measure (ILQ^{Amihud}), which quantifies the the price impact of a trade per unit traded. On average, ILQ^{Amihud} is 1.22%, indicating that an average bond experiences a price movement of 1.22% when a trade of $1 million takes place. The second measure we employ is the Roll illiquidity measure (ILQ^{Roll}), which represents the bid-ask spread expressed as a percentage. The average of ILQ^{Roll} is 1.23% with a standard deviation of 1.89%. The distribution of these illiquidity measures aligns closely with previous studies such as Dick-Nielsen, Feldhütter, and Lando (2012) and Schestag, Schuster, and Uhrig-Homburg (2016).

4 Empirical Results

4.1 Debt Refinancing and Corporate Bond Returns

In this section, we examine the relationship between a firm's rollover risk, represented by debt refinancing intensity (RI), and its future returns at the bond-month level. As discussed in the Section 2, bond investors may demand a higher risk premium when there is higher rollover risk caused by short-term leverage, while the potential benefit of refinancing flexibility may reduce agency costs, leading to lower bond returns. To examine the effect of short-term leverage on corporate bond returns, we employ a panel regression approach to perform monthly regressions on individual bond returns, while controlling for time fixed effects and firm fixed effects. The model is specified as follows:

$$R_{i,t+1} = \alpha + \beta RI_{j,t} + \gamma' Controls_{i,j,t} + \tau_t + \lambda_j + \epsilon_{i,t+1} \tag{4}$$

where i indexes bond, j indexes firm and t indexes year. $R_{i,t+1}$ denotes bond i's monthly excess return in year $t+1$. Debt refinancing intensity (RI) is defined as the proportion of short-term debt to total debt. To account for factors that may affect bond returns, the analysis includes a set of firm and bond-level variables, consistent with previous research on corporate bond returns (Lin et al., 2011). First, we include LEV, defined as total debt to total assets, as a crucial control variable to assess whether the relationship between RI and bond returns is merely a manifestation of a firm leverage (Friewald et al., 2022). Second, we control return on equity (ROE), which is widely used as firm-level controls in bond return literature. Third, our analysis includes several bond characteristics, such as bond maturity, credit rating, issue size, reversal return, bond illiquidity measures as in Amihud (2002) measure and a dummy variable for callable bonds. Additionally, year (τ) fixed effects and bond issuer (λ) fixed effects are included in the regression to account for potential time-series trends and other unobserved firm characteristics.

Table 2 shows several key results. Panel A shows that the coefficients of RI are significantly positive, in the presence of LEV and other variables known to affect bond returns. First, in Column (1), we conduct a univariate regression of firms' excess returns on their debt refinancing intensity, denoted as RI. In Column (2), we include both RI and LEV (leverage ratio) jointly. On the one hand, our results suggest that bond returns are unrelated to leverage —the estimated coefficients for LEV is insignificant in all specifications. On the other hand, we find a positive link between RI and bond returns (t-statistic = 2.32), which implies that excess bond returns increase in a firm's fraction of short-term relative to total debt. Second, the positive correlation between RI and bond returns remains robust after controlling for various bond issuer - and firm-level variables. As shown in Columns (3) and (4), the correlation between RI and bond returns is both economically and statistically significant. Third, the economic significance of the predicting power is also sizable. For instance, in Column (4), the coefficient estimate for RI is 0.165 (with a t-statistic of 3.18). This suggests that, a one standard deviation increase in RI measure is associated with an increase of 2.64 bps (0.16 x 0.165 = 0.0264 %) in monthly bond returns over the following year, which is equivalent to approximately 32 basis point of the annualized excess bond return. This increase is about 6% of the average value of excess bond return during the sample period, considering that the average annualized excess bond return in the sample stands at 5.4 %.

Panel B of Table 2 reports the results of the main specification of Eq.(4) in the sample that excludes AZL firms (those with LEV $<$ 0.05). Using the same control variables and fixed effects as in Table 2, the results of RI are even stronger, both economically and statistically, with significant coefficient estimates at the 1% level in all univariate and joint regressions (t-statistic between 2.68

and 3.37). After excluding the AZL firms, the fact that the *RI* results are stronger while the coefficients on leverage are insignificant indicates the importance of conducting a joint analysis of both leverage and debt maturity effects. Another interesting observation is that, although the coefficient estimates in Panel B are stronger than those in Panel A, the number of observations does not change significantly. For instance, in Column (3), the number of observations decreases from 296,864 in Panel A to 290,040 in Panel B, representing a change of only -2.3% in sample size. Compared to the sample of equity-issuing firms in Friewald et al. (2022), a smaller proportion of bond-issuing firms meet the criteria to be classified as "zero-levered" in our sample. Because our sample consists only of public firms that issue bonds in the US markets. As a result, in the subsequent empirical tests, we utilize the entire sample of firms. This decision is based not only on the subtle difference between the overall sample and the exclusion of the zero-levered (AZL) group but also on our preference for a more conservative approach in the subsequent tests. Note that the *RI* coefficient in Panel A is 0.165, which is slightly smaller than the coefficient in Panel B, which is 0.196.

The estimated coefficients on the control variables are consistent with findings from previous studies (Huynh and Xia, 2021; Huang et al., 2023). In Column (4), *ROE* is negative and statistically significant. This implies that firms with lower *ROE* tend to have higher bond returns. Regarding the bond characteristics, maturity, credit rating, and issue size have positive and highly statistically significant coefficients. This suggests that bond investors require higher returns for bonds with longer maturities, issued by firms with lower credit quality, and larger issue sizes. Return reversal displays a negative and highly statistically significant, indicating that investors require higher risk premia for bonds whose returns tend to exhibit negative autocorrelation. The illiquidity measure shows a positive and significant relationship, aligning with the findings of the bond liquidity literature, which suggests a negative association between bond liquidity and returns.

In sum, the regression results indicate a positive link between the bond returns of firms and their intensity of debt refinancing. The observation that bond returns increase as the proportion of short-term debt (compared to total debt) increases offers preliminary support for the presence of debt maturity effects on expected bond returns. This finding highlights the role of debt rollover risk, rather than financial flexibility, as a possible channel. Our finding is consistent with Friewald et al. (2022), which also identifies the presence of a debt rollover risk channel. These results support the notion that the risk premium in the equity market could manifest itself in the corporate bond market, as bonds and stocks represent claims on the same underlying assets of the firm (Chordia et al., 2017; Choi and Kim, 2018; Kelly et al., 2023). However, the economic magnitudes of debt refinancing effect are noticeably smaller in bond markets when compared to those in Friewald et al. (2022) within the context of equity markets. One possible explanation pertains to the absolute priority rule. Specifically, bondholders hold a higher priority over equity holders in claiming firm assets in the event of corporate liquidation, thereby requiring a smaller premium.

Taken together, the initial findings from Table 2 provide evidence in support of *Hypothesis 1a*, which addresses the rollover risk channel wherein bondholders do not uniformly price all leverage-related risks, thus demanding higher risk premia associated with short-term leverage. This suggests that firms heavily reliant on short-term debt expose themselves to heightened rollover risk due to potential challenges they may face in refinancing maturing debt within a constrained time frame.

4.2 Debt Refinancing and Default Risk

In this section and the next, we consider two significant components of risk premium that are commonly believed to have significant impacts on corporate bond returns - default premium and liquidity premium (Fama and French, 1993; Lin et al., 2011; Bao et al., 2011; Huang and Huang, 2012).[24]

The default risk premium on a firm's bond primarily depends on the creditworthiness of issuing firm (Fisher, 1959). Extensive research by financial economists has emphasized the crucial role of credit risk in shaping the risk premium of corporate bonds, with default risk accounting for a significant portion of this premium (Giesecke, Longstaff, Schaefer, and Strebulaev, 2011; Huang

[24] Recent research has consistently demonstrated the significance of credit risk and liquidity risk as determinants of corporate bond returns. Specifically, Fama and French (1993) highlight the critical role of credit risk in influencing corporate bond returns. Lin et al. (2011) and Bao et al. (2011) show that bond illiquidity in corporate bonds is substantial and document a strong positive relation between corporate bond returns and liquidity risk. Huang and Huang (2012) demonstrate that credit risk accounts for one-third of the variation of yield spreads for investment grade bonds, and a much higher fraction of yield spreads for high-yield bonds. Additionally, Friewald et al. (2012) focus on the liquidity effect in period of financial crisis and find that bond liquidity accounts for 14% of the market-wide credit spread changes.

and Huang, 2012). Firms with higher credit risk face more significant challenges when refinancing their debts. As highlighted in He and Xiong (2012), the interaction between credit risk and rollover risk becomes particularly relevant when the bond approaches maturity. Investors become more concerned about the issuer's ability to refinance the debt, which can lead to a further decline in bond prices and higher yields. As such, this rollover risk is notably exacerbated for firms with higher credit risk due to their weaker financial positions. In contrast, highly-rated issuers possess more bargaining power in the credit market and are less susceptible to rollover risk. Therefore, we expect the impact of refinancing intensity on corporate bond returns to be more pronounced for firms exposed to higher credit risk.

To account for the possible impact of default risk, we add an interaction term between RI and default risk proxies (DEF) to the baseline regression Eq.(4), as follows:

$$R_{i,t+1} = \alpha + \beta_1 RI_{j,t} * DEF_{i,t} + \beta_2 RI_{j,t} + \beta_3 DEF_{i,t} + \gamma' Controls_{i,j,t} + \tau_t + \lambda_i + \epsilon_{i,t+1} \quad (5)$$

where $R_{i,t+1}$ refers to bond i's excess return in year $t+1$. We assess default risk (DEF) using two distinct approaches: the expected default frequency (EDF) and the credit rating ($Rating$). To estimate EDF, we employ the Merton distance to default model proposed by Merton (1974) and utilize the approach outlined in Bharath and Shumway (2008).[25] Further, for each month, we classify the sample into terciles and designate firms falling within the top tercile as high EDF firms ($High\ EDF$). The second measure of default risk is the bond's credit rating. We transform the credit rating, which is a numerical variable ranging from 1 (AAA) to 22 (D), using a logarithmic transformation to obtain a continuous variable ($\ln(1 + Rating)$). Additionally, we define a dummy variable to identify high-yield bonds (HY). The HY variable is a dummy variable that takes a value of 1 if the bond is classified as a high-yield bond (i.e., credit rating ranging from 11 (BB+) to 22 (D)), and 0 otherwise. The coefficient β_1 is the primary variable of interest in this regression as it captures the interaction effect of default risk proxies and RI on future bond returns. The control variables and firm- and year-fixed effects are the same set used in the baseline regressions.

[25] According to Moody's Analytics, EDF credit measures have consistently outperformed the rating agencies in distinguishing between defaulting and non-defaulting firms.

Table 3 presents empirical results. We estimate a bond issuer's default risk using expected default frequency (EDF) for Columns (1)-(2) and credit rating ($Rating$) for Columns (3)-(4). In Column (1), we examine the interaction effect between RI and EDF on bond returns. The coefficient on the interaction term is 1.365, with a t-statistic of 2.14, suggesting that the debt refinancing effect on bond returns is stronger for firms with higher credit risk. Specifically, with a one standard deviation increase in EDF, the effect of RI on future bond returns increase by 12%. To gain further insight into the interaction effect between RI and EDF, we divide the sample into tercile groups based on their EDF values for each month. The top and medium terciles are categorized as high and medium EDF firms, respectively. We then examine the interaction of these two indicators with RI in Column (2). The coefficients on $RI * High\ EDF$ and $RI * Medium\ EDF$ are both positive and significant, confirming a strong debt refinancing effect for firms with higher credit risk. Specifically, a one standard deviation increase in RI is associated with 0.4% and 0.3% increase in monthly bond risk premia for high and medium EDF groups, respectively, while the RI effect for low EDF is found to be insignificant.

In Column (3), we introduce the natural logarithm of (1+Rating) as a proxy for a firm's credit risk. As anticipated, the coefficient on $RI * Ln(1 + Rating)$ is positive and statistically significant, indicating that the effect of RI on future bond returns is amplified when credit risk is higher. Interestingly, when we include the interaction term, the coefficient on RI becomes negative. This shift in the coefficient could be attributed to the influence of the financial flexibility of short-term leverage on low credit risk firms. Specifically, the effect of RI on bond returns is negative for bonds with a credit rating of AA- or higher, but positive for bonds rated A+ or lower. For instance, for a credit rating of 5 (A+), which corresponds to the 20th percentile of our sample, the RI effect is positive at 0.03.[26] In addition, the RI effect for BBB- rated bonds amounts to 0.26 and a one standard deviation increase in RI is associated with a 0.04% increase in monthly bond returns.

In Column (4), we use the high-yield dummy variable (HY) as a proxy for high credit risk and run the same set of regressions. High-yield dummy takes on value of one for bonds with ratings of BB+ or lower, and zero otherwise. The coefficient on $RI * HY$ is 1.19, with a corresponding

[26]Taking Ln(1+5) = 1.79, multiplying it by 0.428 gives 0.77. Adding this to the coefficient on RI (-0.74) yields a total RI effect of 0.03 for bonds with rating of A+.

t-statistic of 4.78. This implies that a one standard deviation increase in RI is associated with a 19 basis point increase in monthly bond returns, which is equivalent to a 2.28% increase in annual bond returns. Moreover, we find that the coefficient on RI becomes insignificant, indicating that the impact of RI on bond returns seems to be primarily concentrated on high-yield bonds. Considering the insights gained from Column (3), we argue that the insignificant coefficient in this column may be attributed to a mixed effect of RI among investment-grade bonds, resulting in an overall lack of significance for RI.

Overall, our empirical findings in Table 3 suggest that the effect of RI on corporate bond returns is more pronounced when a firm is exposed to higher credit risk. This aligns with He and Xiong (2012)'s calibration, which indicates that market confidence in a firm's ability to rollover their debts changes as a function of the credit risk of firms with different credit ratings and debt maturities. As our results demonstrate, this debt rollover risk is significantly intensified for firms with high expected default frequency and lower credit ratings.

4.3 Debt Refinancing and Bond Liquidity

In this analysis, we investigate whether the impact of debt refinancing intensity on corporate bond returns is amplified when the bond is exposed to higher levels of liquidity risk. Liquidity is a critical pricing factor in the US corporate bond market, as bonds with higher liquidity levels typically exhibit lower expected returns compared to similarly rated bonds with lower liquidity(Lin et al., 2011; Bao et al., 2011; Friewald et al., 2012). An interesting and unique aspect of this market is that liquidity discrepancies across individual bonds are quite apparent: very few bonds are traded frequently, while most other bonds are rarely traded at all (Mahanti, Nashikkar, Subrahmanyam, Chacko, and Mallik, 2008). Additionally, trading in the US corporate bond market involves significantly higher transaction costs compared to the stock market, leading market participants to expect significant liquidity premia, as argued by Amihud and Mendelson (1986).

Liquidity risk is a pivotal determinant of corporate bond returns, prompting investors to seek elevated returns in exchange for holding less liquid bonds (Bao et al., 2011; Lin et al., 2011). Therefore, when a company with illiquid bonds undergoes debt refinancing, it may need to offer better terms, such as higher yields, to attract investors. Consequently, investors may require a higher risk premium for less liquid bonds due to the potential challenges associated with refinancing. This leads to a stronger positive relationship between debt refinancing intensity (RI) and bond returns for illiquid bonds as compared to more liquid counterpart.

To test our conjecture, we include the interaction term between RI and $Illiquidity$ to the baseline model and perform the following panel regression:

$$R_{i,t+1} = \alpha + \beta_1 RI_{j,t} * Illiquidity_{i,t} + \beta_2 RI_{j,t} + \beta_3 Illiquidity_{i,t} + \gamma' Controls_{i,j,t} + \tau_t + \lambda_i + \epsilon_{i,t+1} \quad (6)$$

The specification is similar to Eq.(5) except we interact RI with $Illiquidity$. We apply the same set of control variables and fixed effects as before. Bond illiquidity is measured using the Amihud illiquidity measure (Amihud, 2002) for the first two columns and the Roll illiquidity measure (Roll, 1984) for the next two columns. A higher value of the illiquidity measures implies that the bond is more illiquid. The results are presented in Table 4, where the coefficient on the interaction term reflects the impact of bond illiquidity on the relationship between debt refinancing and corporate bond returns, and we anticipate a positive value for the coefficient estimate β_1 of the interaction term.

In Columns (1), we use the Amihud (2002) illiquidity measure as a proxy for bond illiquidity. Consistent with our expectations, we find that the coefficient of RI and $Illiquidity$ is positive and significant at the 5% level. This suggests that the positive effect of debt refinancing on bond returns is amplified in the presence of higher illiquidity levels. In addition, we find that the coefficient on RI is insignificant, suggesting that the debt refinancing effect concentrating on bonds with greater illiquidity level. In Column (2), we divide the sample into three groups based on Amihud measure for each month. The $High\ ILQ$ group represents the top tercile with the most illiquid bonds, while the $Medium\ ILQ$ group denotes the middle tercile with moderately liquid bonds. We interact RI with dummy variables of high and medium illiquidity bonds. Interestingly, we find that the coefficient on RI and $High\ ILQ$ is positive and significant, suggesting that the liquidity is primarily among illiquid bonds. Specifically, a one standard deviation increase of RI is associated with a 0.04% increase in monthly bond returns for the high illiquidity bonds.

Next, we employ the Roll illquidity measure for Columns (3) and (4). Consistent with previous findings, we observe that the interaction terms between RI and $Illiquidity$ is positive and statistically significant in Column (3). Notably, we find that the effect of illiquidity on debt refinancing is stronger in comparison. In Column (4), the coefficient on $RI * High\ ILL$ is 0.647, which is significant at the 1% level, while the coefficient on $RI * Medium\ ILL$ is 0.140, significant at the 10% level. These results suggest that a one standard deviation increase in RI leads to a 0.1% and 0.02% increase in monthly bond returns for the most illiquid and medium illiquid bond groups, respectively. In addition, the insignificant coefficient on RI indicates that investors do not appear to be significantly concerned about rollover risk when bonds can be readily bought or sold in the market without substantially impacting their prices.

In summary, our empirical findings in Table 4 indicate that illiquidity plays a crucial role in the relationship between short-term leverage and bond returns. Our findings shed light on the existing literature regarding bond return predictability (Bekaert, Harvey, and Lundblad, 2007; Amihud, Hameed, Kang, and Zhang, 2015). We propose that the market participants should consider not only the liquidity component of corporate bonds but also its interaction with the debt maturity structure at the firm level. By considering both components simultaneously, we can better understand and assess their substantial impact on future bond premia.

4.4 Debt Refinancing and Bond Maturity

Highlighting the heterogeneity in corporate bond term structures, Merton (1974)'s seminal work delves into the relationship between maturity variations and the risk associated with a firm's bonds. We thus propose that the relationship between debt refinancing intensity and corporate bond returns exhibits an interesting pattern with respect to bond maturities.

There are two possible opposite directions for bond maturities in this context. On the one hand, bonds issued with shorter maturities might be subject to more severe refinancing risk because these bonds mature sooner, leading to a higher likelihood of earlier or more frequent refinancing. On the other hand, the positive correlation between these two factors could be more pronounced for bonds with longer maturities. In other words, as the intensity of debt refinancing increases, its impact on corporate bond returns will be more significant for bonds with longer maturities compared to those with shorter maturities. This vulnerability is due to the fact that bonds with longer maturities are particularly exposed to a firm's debt refinancing needs, as an extended time horizon increases the likelihood of refinancing needs (Diamond and He, 2014).

To examine these two possibilities, we investigate how the effect of debt refinancing on bond returns varies across different maturities. Similar to the previous regression specification, we include the interaction term between RI and $Maturity$ to our baseline regression, as follows:

$$R_{i,t+1} = \alpha + \beta_1 RI_{j,t} * Maturity_{i,t} + \beta_2 RI_{j,t} + \beta_3 Maturity_{i,t} + \gamma' Controls_{i,j,t} + \tau_t + \lambda_i + \epsilon_{i,t+1} \quad (7)$$

where β_1 captures the effect of bond maturity on the relation between RI and future bond returns. We anticipate a positive coefficient if the debt refinancing poses a higher risk for long-term bonds. Two measures of maturity are applied in our model. The first measure is the natural logarithm of maturity in years ($Ln(Maturity)$). For the second measure, we divide the sample into three groups based on their maturity structure: short-maturity bonds ($Short - Term$) mature between one year and five years, medium-maturity bonds ($Medium - Term$) mature between five years and ten years, and long-maturity bonds ($Long - term$) have a maturity of ten years or more.

The regression results are presented in Table 5. In Column (1) , we use $Ln(Maturity)$ to proxy bond maturity. Consistent with expectations, the coefficient on the interaction term is positive and significant at the 5% level, indicating a stronger debt refinancing effect for bonds with longer maturity. In Column (2), we use dummy variables to represent different maturity groups. Notably, the coefficients on $RI * Long - term$ are positive and highly significant at the 5% level, indicating that the debt financing effect is particularly strong for long-term bonds. Specifically, an increase of one standard deviation in RI is linked to a 0.9 % increase in annualized risk premium for long-term bonds compared to short-term bonds. In other words, when a firm is more exposed to rollover risk, investors require a higher risk premium for long-term bonds. In contrast, the coefficients on $RI * Medium - term$ and RI are both statistically insignificant. This implies that the debt refinancing effect on risk premia primarily applies to long-term bonds.

Our results demonstrate that the interaction between debt refinancing intensity and corporate bond returns is influenced by the maturity of the bonds. This interaction suggests that if a firm incurs losses while rolling over maturing debt, long-term bond holders absorb these losses and seek an elevated risk premium, while holders of maturing debt are typically paid in full. As a result, companies with a higher proportion of short-term debt on their balance sheets are more likely to face higher refinancing costs for their long-term bonds. In this context, short-term bonds encounter fewer risks associated with such obligations.

In a nutshell, our empirical findings indicate that the impact of debt financing is more pronounced for bonds with longer maturities.This implies that bondholders may seek higher returns for long-term bonds issued by firms with a higher proportion of short-term debt on their balance sheets, reflecting the increased refinancing risks associated with such bonds.

5 Debt Refinancing under Various Market Conditions

In this section, we explore the intriguing implications of debt refinancing on expected bond returns across diverse market scenarios, with a specific focus on examining how this relation significantly intensifies during periods of credit market freezes, heightened interest rates, and low investor sentiment. This sheds light on the intersection of debt refinancing and market fluctuations, aiming to demonstrate that the debt refinancing risk premium experiences significant intensification under stressed conditions.

5.1 Debt Refinancing and Credit Market Freezes

The structure model of credit risk suggests that the interplay between default risk and liquidity risk may have a significant effect on bond risk premia, particularly for firms facing debt rollover needs. As shown in He and Xiong (2012), the deterioration in debt market liquidity leads not only to a higher liquidity premium but also to a higher default premium, making it difficult to separate liquidity risk from credit risk. In other words, the two types of risk are intertwined and cannot be considered in isolation. Furthermore, credit market freezes, characterized by substantial declines in transaction volumes in both primary and secondary markets occurring over extended periods, are typically observed during crisis periods (Benmelech and Bergman, 2018). These crises provide unique opportunities to examine the interplay between credit and liquidity risk concerning the impact of debt financing intensity on bond risk premia.

In this section, we employ the financial market crisis as an exogenous shock and examine how the impact of debt refinancing risk is influenced when both credit and liquidity levels are simultaneously worsened. We use a similar specification to the baseline model, incorporating an interaction term between the *RI* measure and the *Crisis* dummy variable. The empirical specification is designed as follows:

$$R_{i,t+1} = \alpha + \beta_1 RI_{j,t} * Crisis + \beta_2 RI_{j,t} + \beta_3 Crisis + \gamma' Controls_{i,j,t} + \tau_t + \lambda_i + \epsilon_{i,t+1} \quad (8)$$

The main variable of interest is the interaction term between *RI* and *Crisis*, which captures the impact of the debt refinancing on bond returns during crisis periods. *Crisis* is a dummy variable for periods characterized by a frozen credit market. Specifically, we designate the global financial crisis (*GFC*) and pandemic crisis (*PC*) as proxies for the credit market freezes during our sample period. Specifically, global financial crisis period is defined as the period from December 2007 to June 2009, while the pandemic crisis period is defined from February to March of 2020.[27]

Table 6 illustrates the results. Column (1) represents the findings of test that examines the interaction effect between *RI* and *GFC*, considering both firm-level and bond -level control variables. The coefficient estimate of the interaction term is 1.33, which is statistically significant at 1% level (t-statistics = 3.87). More specifically, the results indicate that, during the financial crisis, a one standard deviation rise in *RI* is linked with a 0.21% increase in future monthly bond returns, which translates to a 2.52% increase in annual bond returns. The economic magnitude is substantial, approximately eight times greater than the reported refinancing effect outlined in Table 2. This result is also consistent with that of Lin et al. (2011)'s study, which suggests that bonds with higher sensitivity to market-wide liquidity shocks offer higher returns. It is worth emphasizing that the coefficient estimate β_2 represents the impact of *RI* on bond returns specifically during non-crisis conditions in the sample periods. While the estimate remains positive, it is statistically significant

[27] The identification of crisis periods adheres to the business cycle dates as determined by the National Bureau of Economic Research (NBER).

at the 10% level, indicating a relatively smaller effect (decreasing from 0.165 in panel A of Table 2 to 0.079). However, when we consider the influence of the financial crisis, the coefficient estimate for RI undergoes a significant increase, suggesting that the effect of refinancing risk becomes more pronounced during the crisis. This finding is consistent with the results reported in Almeida et al. (2011).

Moving forward, we employ the pandemic crisis dummy variable as a proxy for the credit market freeze condition. As reported in Column (2), our analysis reveals a significantly stronger impact of debt refinancing on expected corporate bond returns. At the onset of the crisis, the corporate bond market experienced a brief crash, swiftly rebounding due to the robust intervention by the Federal Reserve. Consistent with the brief shock to the bond market, we observe a substantial and negative coefficient on PC, indicating an average monthly return decline of -8.4% in February and March of 2020. More interestingly, we find a coefficient of 6.65 (with a t-statistic of 5.92) on $RI * PC$. This magnitude is five times larger than during the financial crisis period, primarily driven by the rapid shock to the credit market throughout the pandemic period.

As a whole, the results from Table 6 suggest that the rollover risk, which becomes increasingly prominent during crisis periods, is a critical factor for bond investors. At times of elevated risks, investors typically demand higher risk premia, as demonstrated by increased expected bond returns. This heightened expectation is a direct consequence of exogenous default and liquidity shocks, such as the financial crisis, where the need for greater rollover risk premia arises in response to the perceived instability and unpredictability of the market environment (Brunnermeier and Pedersen, 2009; He and Krishnamurthy, 2012).

5.2 Debt Refinancing and Interest Rate Environment

In this subsection, we delve into the interaction effect of debt refinancing and different interest rate environments on corporate bond returns. Notably, the sensitivity of the debt structure to fluctuations in interest rates has been demonstrated by Leland (1994) and Goldstein, Ju, and Leland (2001). The ramifications of different interest rate scenarios on debt refinancing can carry substantial implications for both borrowers and lenders alike. Refinancing existing debt in a high-interest-rate environment leads to higher interest expenses, resulting in a higher bond premium. In addition, interest rates fluctuate over time, creating a changing interest rate environment. Specifically, during an increasing interest rate environment, refinancing becomes more costly for firms seeking to replace existing debt, causing investors to demand higher compensations. To examine this interaction effect, we perform the following regression:

$$R_{i,t+1} = \alpha + \beta_1 RI_{j,t} * FRR + \beta_2 RI_{j,t} + \beta_3 FRR + \gamma' Controls_{i,j,t} + \tau_t + \lambda_i + \epsilon_{i,t+1} \tag{9}$$

where β_1 captures the interaction effect of different interest rate environments and refinancing intensity on future bond returns. The variable FRR refers to the dummy variable for various interest rate environments. To identify the high interest rate environment, we rely on historical federal funds rate. The average federal funds rate is 1.40% over the sample period, with values ranging from 0.09% at the 10th percentile to 4.5% at the 90th percentile. We use two dummy variables to proxy the high interest rate environment. The first dummy variable ($FFR \geq 2\%$) is based on the federal funds rate being 2% or more, which serves as the threshold for the 75th percentile of the sample federal fund rate. The second dummy variable ($FFR \geq 4.5\%$) is based on the federal funds rate being 4.5% or more, the threshold for the 90th percentile. These dummy variables allow us to capture periods when the interest rates were relatively high. To identify the periods of rising interest rates, we use the interest rate hike announcements made by the Federal Reserve. Throughout the sample period, the Federal Reserve has implemented interest rate hikes a total of 26 times. In our analysis, we consider the refinancing effect during the month of the announcement and the subsequent month as the treatment period.[28] Thus, our initial approach involves utilizing the dummy variable, *FFR Increase*, to identify the periods with interest rate hikes. In addition, we take into account the cumulative changes of federal fund rates over the past one-year periods. Specifically, we examine two types of cumulative changes in federal fund rates: those between 25 to 100 bps denoted as *FFR Inc. 25-100 bps*, and those exceeding 100 bps referred

[28] In an untabulated table, we explore the effects over the entire interval of a series of interest rate hikes. For instance, if the Fed raises the interest rate in the first month of the year and follows up with another increase three months later, we treat the entire three-month period as the treated period. Employing this alternative approach yields comparable results, reinforcing the robustness of our findings.

to as *FFR Inc.* $> 100bps$.

Table 7 presents the panel regression results, revealing a compelling story about the debt refinancing effect, particularly in high-interest rate environments and periods of interest rate hikes. In Column (1), we observe that during periods when the federal fund rate is 2% or higher, a one standard deviation increase in a firm's refinancing intensity (RI) leads to a monthly excess return increase of 5.62 bps (equivalent to 67 bps per annum). Notably, as depicted in Column (2), the interaction effect becomes even more pronounced when the average interest rate reaches 4.5% or higher. We observe that a one standard deviation increase in RI is associated with an impressive 17.7 bps monthly excess return increase, equivalent to 212 bps per annum. These findings suggest that a high-interest rate environment may lead to elevated financing costs, causing borrowers to demand a higher risk premium, thereby intensifying the debt refinancing effect.

In Column (3) and (4), we observe a noteworthy trend wherein the refinancing effect strengthens during periods of increasing interest rates. Specifically, a one standard deviation increase in RI leads to a 7 bps increase in monthly excess returns during periods characterized by federal fund rate hikes. To account for historical interest rate changes, we construct dummy variables for cumulative interest rate hikes between 25-100 bps and those exceeding 100 bps, respectively. As expected, our findings indicate that the debt refinancing effect becomes even more pronounced when the cumulative interest rate changes are greater. This intuitively aligns with the notion that higher interest rates impose additional financing costs on firms, making refinancing more challenging and, consequently, enhancing the refinancing effect.[29]

5.3 Debt Refinancing and Investor Sentiment

During periods of low investor sentiment, credit supply tightens and credit market conditions manifest increased risk aversion, with debt issuers being relatively higher in quality (Yu and Yuan,

[29] As intriguing anecdotal evidence, the Wall Street Journal reports that "higher interest rates have CFOs weighing whether it is better to sell bonds now or turn to shorter-term options." (https://www.wsj.com/articles/with-debt-coming-due-investment-grade-companies-are-paying-up-too-11669871795)

2011; Greenwood and Hanson, 2013; Bekaert et al., 2022),[30] thereby investors demand higher risk premia. Thus, we expect the impact of refinancing intensity on future bond returns should be magnified in a market characterized by low investor sentiment. To test the conjecture, we use two approaches to proxy investor sentiment.

The first approach we employ is the risk aversion index developed by Bekaert et al. (2022), denoted as RA^{BEX}. This index utilizes a dynamic no-arbitrage asset pricing model that incorporates equities and corporate bonds. It serves as a measure of aggregate risk aversion that varies over time, reflecting the prevailing risk appetite of market participants. Higher values of the index indicate greater levels of risk aversion among market participants. We further define a period of high risk aversion ($High\ RA$) as one in which the risk aversion index falls within the top quintile of for the preceding month.

The second approach is the issuer quality measure introduced by Greenwood and Hanson (2013), referred to as IQ^{GH}. This measure estimates the average differences in issuer quality between high and low net debt issuer firms. The IQ^{GH} measure takes on high values when low-quality firms are disproportionately issuing debt securities. Increased issuance of low-quality (i.e., high-EDF) bonds is indicative of prosperous periods in the corporate bond market when investor sentiment is strong. Conversely, we define a period of low sentiment ($Low\ IQ$) as one in which the issuer quality measure falls within the bottom quintile for the preceding quarter.[31]

To investigate the impact of investor sentiment on the debt refinancing risk premium, we augment the baseline regression model Eq. (4) by incorporating interaction terms between RI and the proxies on investor sentiments ($Sent$). The regression model is expressed as follows:

$$R_{i,t+1} = \alpha + \beta_1 RI_{j,t} * Sent + \beta_2 RI_{j,t} + \beta_3 Sent + \gamma' Controls_{i,j,t} + \tau_t + \lambda_i + \epsilon_{i,t+1} \qquad (10)$$

where $Sent$ represents variables for risk aversion and issuer quality index, respectively. All other

[30] Yu and Yuan (2011) demonstrate that investor sentiment affects the market's mean-variance tradeoff. The tradeoff is stronger in low-sentiment periods and notably lower and flatter in high-sentiment periods. Greenwood and Hanson (2013) show that corporate debt issuers experience a decline in credit quality amidst credit booms, which in turn predicts diminished excess returns for corporate bondholders. Bekaert et al. (2022) document a strong correlation between risk aversion and 16 widely used sentiment and confidence measures. Specifically, the risk aversion index takes on high values in times of diminished investor sentiment.

[31] Consistent with Greenwood and Hanson (2013), we estimate the issuer quality measure at a quarterly frequency.

variables are defined the same manner as described in Eq.(4). The regression results are reported in Table 8. Specifically, the results of the model that employs the RA^{BEX} measure are reported in Columns (1) and (2), and the IQ^{GH} results are reported in Columns (3) and (4).

In Column (1), we examine the impact of risk aversion on the debt refinancing risk premium. As expected, the coefficient on the interaction between RI and Ln (RA^{BEX}) is positive, indicating that the debt refinancing premium increases during periods characterized by elevated risk aversion. Put differently, this suggests that investors demand higher risk premia when they are burdened with greater amount of maturing debt, particularly in situations when credit market sentiment is pessimistic. Moving on to Column (2), the coefficient for the interaction term between RI and $High\ RA$ is 0.432, significant at the 1% level with a t-statistic of 2.75. This result carries twofold implications: Firstly, the impact of RI under high risk aversion conditions is notably more pronounced compared to other sample periods. Compared to Table 2, where the RI coefficient is 0.165, the impact of RI on refinancing risk premia more than doubles when aggregate risk aversion among market participants is high. Secondly, a one standard deviation increase in RI corresponds to a 0.08% increase in monthly excess bond returns (equivalent to a 0.96% increase in annualized bond returns) when the $High\ RA$ dummy equals 1.

Next, we use the issuer quality index as a proxy for market sentiment conditions. In alignment with our previous findings, we reveal a stronger impact of RI on refinancing risk premia during low sentiment periods. To elaborate further, in Column (3), the coefficient on the interaction between RI and Ln ($1 + IQ^{GH}$) is both negative and statistically significant. This indicates that when the issuer quality index takes a high value while the issue quality is relatively low, investors require lower refinancing premia. Further, during periods characterized by low sentiment ($Low\ IQ$) market conditions, a one standard deviation increase in RI is associated with a 0.26% increase in monthly excess bond returns (equivalent to a 3.12% increase in annualized bond returns). Taken together, our results in Table 8 indicate that bondholders demand higher premia for refinancing risk when the market experiences lower investor sentiment.

6 The Premium for Debt Refinancing Risk

In this section, we conduct a portfolio analysis to measure the risk premium associated with debt refinancing risk. Following this, we investigate how this premium interacts with stock and bond risk factors that serve as proxies for systematic risk. By doing so, we aim to gain a better understanding of the significance and implications of debt refinancing risk in determining expected bond returns.

We employ portfolio procedures commonly used in empirical asset pricing studies. To commence, we conduct a triple 2×3×3 sort based on firms' rating (i=1,2), maturity (j=1,2,3) and debt refinancing intensity (k=1,2,3). The portfolios are constructed from independent sorts, enabling us to separate the premia associated with credit ratings from the premia associated with debt refinancing risk while also controlling for bond maturity effects. We denote the excess returns of the 18 portfolios by R_t^{ijk} and capture return differentials associated with debt refinancing intensity ($R_{RI,t}$) from the respective portfolio intersections by

$$R_{RI,t} = \frac{1}{6}\left(\sum_{i=1}^{2}\sum_{j=1}^{3} R_t^{ij3} - \sum_{i=1}^{2}\sum_{j=1}^{3} R_t^{ij1}\right) \tag{11}$$

As clarified initially, our goal here is not to search for new debt-related bond risk factors. Instead, we employ these procedures to estimate the premia associated with the debt maturity structure in a manner consistent with the construction of portfolio risk factors that have demonstrated success in pricing the cross-section of bond returns. The similar spirit is also applied in Friewald et al. (2022).

6.1 Portfolio Summary Statistics

Table 9 presents summary statistics for the portfolios used in computing the premia for rating, maturity and debt refinancing risk. First, we note that there is little dispersion in RI for both the investment-grade and high-yield portfolios (0.27 for both), as well as for the short-term and long-term portfolios (0.28 and 0.27 respectively). Consistent with prior research (Fama and French, 1993), we find that bond rating and the term of maturity are two primary determinants of bond returns. The HY-minus-IG return differential is 0.39% per month for EW and VW portfolios. Similarly, the long-minus-short return differential is 0.39% for EW and 0.36% for VW portfolios. Second, the variation in rating and maturity is small across RI portfolios. The average rating of high-RI portfolio is 9.7 (10 is equivalent to BBB- rating) and the average rating of low-RI portfolio is about half notch higher at 10.2 (i.e., rated slightly below BBB-). By contrast, the rating difference is more than 6 notches between IG and HY portfolios (6.85 versus 12.98). Additionally, the average maturity of high-RI portfolio is slightly shorter than that of the low-RI portfolio (10.6 vs. 11.1).

By closely examining the portfolio averages of firm and bond characteristics commonly employed in constructing risk factors, we observe notable differences between the low and high RI portfolios. First, the average firm size ($MCAP$) of high RI portfolio is more than twice than that of the low RI portfolio. In terms of the M/B ratio, high RI group is slightly higher than low RI (2.76 versus 2.68). Second, the average asset growth of the high RI group is less than half that of the low RI group (0.08 versus 0.03). This suggests that firms burdened with more short-term debt have limited opportunities to grow their total assets since they frequently need to refinance their short-term debt. However, the high RI group demonstrates higher profitability, with an average return of 0.10 compared to 0.07 for the low RI group. Third, the bond market β (β^{Bond}) is 1.21 for high RI portfolio while it is 1.28 for low RI portfolio. Finally, the illiquidity measure Amihud (2002) demonstrates that the high RI portfolio is almost twice as high as the low RI portfolio.

These results provide valuable economic insights into the characteristics and differences between the low and high RI portfolios, shedding light on factors such as firm size, profitability, asset growth, market sensitivity, and bond liquidity.

6.2 Spanning Regression Results

By applying factor mimicking portfolio procedures, we gain insight into the connection between debt-related premia and systematic risk, and determine whether these premia can be explained by standard risk factors. Specifically, in our analysis of the premia related to debt refinancing risk, we employ the high-minus-low returns from Eq. (11). Our aim is to investigate whether these return differentials adequately compensate bondholders for their exposure to systematic risk. To achieve this, we conduct spanning regressions utilizing a number of factors that are priced in expected bond returns. This selection is driven by prior studies, showing that Fama and French (1993) three factors (Elton et al., 2001), as well as term and default factors (Fama and French, 1993) and liquidity factor (Lin et al., 2011) are priced in corporate bonds.

Table 10 presents the time-series averages of the high-minus-low return differentials based on refinancing intensity, along with the results of spanning regressions using the stock and bond risk factors. In the spanning regressions, we employ the Fama and French (1993) three factors for specifications (2) and (6), default and term spreads as well as liquidity factor for specifications (3) and (7), and all six factors for specifications (4) and (8). The Fama-French three factors (MLT^{Stock}, SMB and HML) are retrieved from Ken French's website. The default spread (DEF) is the difference between the monthly returns of long-term investment-grade bonds and long-term government bonds. The long-term investment-grade bond returns are based on a value-weighted portfolio that includes all investment-grade bonds in our sample with at least ten years to maturity. The weight is determined by the market value of a bond, which is the number of units outstanding times market price of the bond. The term spread ($TERM$) is the difference between the monthly return of the long-term government bond and the one-month T-bill rate. We also use the liquidity risk factor (LIQ) introduced by Lin et al. (2011) for the corporate bond market. Specifically, we estimate the liquidity beta over a five-year rolling window for each individual bond and then sort the individual bonds into ten decile portfolios each month by the preranking liquidity beta. The liquidity factor is defined as the average return difference between the high liquidity beta portfolio (decile 10) and the low liquidity portfolio (decile 1). All t-statistics, enclosed in brackets, are calculated using HAC standard errors with Newey and West (1987) method and the optimal truncation lag recommended by Andrews (1991).

We report equal-weighted portfolio results in Columns (1)-(4). In Column (1), we show that the RI premium is significantly positive with an estimate of 0.10% per month (t-statistic = 2.18). Next, we introduce the Fama and French (1993) three factors in Column (2) and find that they exert little influence on the RI premium. Specifically, we note a positive and statistically significant intercept of 0.086 (t-statistic = 1.93), although the coefficient on the intercept diminishes in magnitude and significance. Moving on to Column (3), we include default and term spreads as well as liquidity factor (LIQ), to the spanning regressions. For the refinancing premium, we find significantly positive loadings on the default spread (t-statistic = 1.92) and the liquidity factor (t-statistic = 2.28). However, we do not find a statistically significant alpha, nor do we observe a significant loading on the term spread. In the specification (4), we expand our analysis by including all six factors into the spanning regression. Consistent with our prior findings, the intercept remains statistically insignificant. However, the loadings on DEF and LIQ continue to be positive and statistically significant (t-statistic = 1.79 and 2.25, respectively). It's important to note that the coefficient on LIQ reaches significance at the 5% level, underscoring the strong connection between the RI risk premium and liquidity risk. We also provide value-weighted portfolio results in Columns (5)-(8), and these results align consistently with the findings in the equal-weighted portfolios.

These results show that bond returns exhibit a positive premium for debt refinancing risk. A higher immediacy of debt refinancing is associated with higher bond returns, reflecting an increased exposure to systematic risk. Specifically, the positive exposure to credit risk factor and liquidity risk factor illustrates the compensation for debt refinancing risk. These findings align with our proposed hypotheses, emphasizing the pricing of credit risks and liquidity risks in relation to firms' debt maturity structures. In total, our results highlight the crucial role of short-term debt in magnifying a firm's rollover risk, as initially discussed in the model proposed by He and Xiong (2012).

7 Conclusion

Our paper offers a unique perspective on bond returns by examining the relationship between debt maturity structure and leverage-related premia in corporate bond returns. We construct a debt refinancing intensity (RI) variable, a proxy for short-term leverage, that captures a firm's short-term refinancing needs and show that bonds with a higher RI are associated with a higher excess return in the next period, and the effect of RI is more pronounced under conditions of more intense default and liquidity risk. Our empirical evidence shows that bond premia associated with short-term and long-term leverage are intrinsically different: bond returns increase in short-term leverage but not in total leverage. This finding indicates that bondholders do not price all leverage-related risk equally.

The principal findings of this paper align with the concept of the debt rollover risk channel. Specifically, bond investors demand higher premia for bonds issued by companies with high levels of short-term debt due to the greater risk of needing to refinance that debt. The empirical finding also demonstrates that this refinancing risk is significantly heightened during challenging circumstances, particularly for bonds with higher levels of credit risk and liquidity risk. Additionally, bonds that are less liquid on secondary markets are subject to greater refinancing risks. Bond investors understand that these less liquid bonds cannot be sold off as easily as the more liquid ones, so they require higher premia to offset any potential losses.

The implications of our findings shed light on corporate finance applications: firms should consider the risk of debt refinancing when choosing their debt maturity structure. When raising external capital, companies need to account for the risk of short-term leverage, rather than just the overall leverage. Furthermore, as proposed in De Fiore and Uhlig (2015), the endogenously evolving debt structure may impact the possibility for companies to switch between bank financing and bond financing. In line with this, since a firm's bond capital becomes more expensive with a higher proportion of short-term leverage, firms may opt to finance more through bank financing. However, if banks also evaluate the risk associated with short-term debt differently, this would ultimately aggregate the refinancing needs for the firms overall. A possible extension would be to investigate the spillover effect of this debt refinancing intensity for firms with financial frictions.

Appendix: Variable Descriptions

This appendix defines the variables used in our analysis. All names in parentheses refer to the annual Compustat item name.

Variable	Definition
Main Variables	
Monthly Bond Return ($r_{i,t}$)	Following Lin et al. (2011), we calculate the monthly corporate bond return i at time t as: $$r_{i,t} = \frac{P_{i,t} + AI_{i,t} + C_{i,t}}{P_{i,t-1} + AI_{i,t-1}} - 1$$ where $P_{i,t}$ is defined as the transaction price, $AI_{i,t}$ as the accrued interest, and $C_{i,t}$ as the coupon payment, if applicable, for bond i in month t.
Excess Bond Return ($R_{i,t}$)	Defined as the monthly return of an individual bond in excess of the one-month T-bill rate.
Refinancing Intensity (RI)	Defined as the ratio of short-term debt (dd1+dd2+dd3) to total debt (dd1+dltt) (Friewald et al., 2022). $$RI = \frac{dd1 + dd2 + dd3}{dd1 + dltt}$$
Control Variables	
Leverage (LEV)	The sum of short-term debt (dd1) and long-term debt (dltt) scaled by total assets (at) at the end of each quarter (Baker and Wurgler, 2002).
ROE	Return on equity, defined as the income before extraordinary items (ib) divided by the book value of common equity (ceq).
Maturity	Bond's time to maturity in years.
Rating	Bond's numerical credit rating based on the following letter rating conversion scheme: AAA=1, AA+=2, ..., C=21 and D=2. We mainly use the Standard & Poor's (S&P) rating from the FISD; when it is not available, we use Moody's or Fitch rating when possible and drop bonds whose ratings are not identified. Following Huynh and Xia (2021), we use natural logarithm of one plus rating ($ln(1 + rating)$) in the regression analysis.
Issue Size	The principal amount outstanding of a given bond in a million dollars.
Reversal	The excess bond returns in the prior month.
ILQ^{Amihud}	The Amihud illiquidity measure (Amihud, 2002). It measures the price impact of a trade per unit traded. For each corporate bond i, the measure is the daily average of absolute returns $r_{i,t}$ divided by the trade size Q_i of consecutive transactions: $$\text{Amihud}_{i,j} = \frac{1}{N}\sum_{t=1}^{N}\frac{\lvert r_i \rvert}{Q_i}$$ where N is the number of returns on day t. At least two transactions are required on a given day to calculate the measure, and we define a monthly Amihud measure by taking the median of daily measures within the month.

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Variable	**Definition**
ILQ^{Roll}	The Roll illiquidity measure. Roll (1984) finds that the percentage bis-ask spread equals two times the square roo of minus the covariance between consecutive returns: $$\text{Roll}_t = 2\sqrt{-cov(R_{t,k},, R_{t,k-1})}$$ where $R_{t,k}$ and $R_{t,k-1}$ are returns to two consecutive trades indexed by k and $k-1$, the covariance is computed over all trades during a 21-day window ending on day t. We require at least one trade during the 21-day window for the daily Roll measure to be valid. Then the monthly Roll measure is the median of all valid daily Roll measures during the month.)
Call	Dummy variable for callable bonds.
Other Variables	
HY	Dummy variable for high-yield bonds that are rated below BBB-.
EDF	The expected default frequency developed by Moody's Analytics to estimate the default probability based on Merton's (1974) framework. The estimation of EDF involves two steps. In the first step, we calculate the distance to default (DD) measure for each individual bond issuer using the following formula: $$DD = \frac{ln(V/D) + (\mu - 0.5\sigma_v^2)T}{\sigma_v\sqrt{T}}$$ where V is the firm's market value; D is the sum of a firm's current debt (dlc) and half of the firm's long-term liabilities (dltt); T is the forecasting horizon of 1 year. Besides, μ denotes the firm's asset return and σ_v represents the firm's asset volatility, both estimated following the approach described in Bharath and Shumway (2008). In the second step, we estimate the default probability as $(1 - Norm(DD))$ where $Norm$ represents a normal cumulative density function.
GFC	Dummy variable for the global financial crisis, defined from December 2007 to June 2009.
PC	Dummy variable for the pandemic crisis, defined from February 2020 to March 2020.
FRR	Federal fund rate, which is a dummy variable representing various interest rate environments.

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Variable	Definition
IQ^{GH}	Measured as the default risk of high-debt issuers (hd) with that of low-debt issuers (ld), following Greenwood and Hanson (2013). We compare the credit quality of firms that issue large amounts of debt to that of firms that issue little debt or are retiring debt. $$IQ_t^{GH} = \frac{\sum_{i \in hd_{it}} \text{EDF Rank}_{it}}{N_t^{hd_{it}}} - \frac{\sum_{i \in ld_{it}} \text{EDF Rank}_{it}}{N_t^{ld_{it}}}$$ where EDF Rank represents the decile rank of a bond issuer's expected default frequency. The numbers of high-debt issuance firms and low-debt issuance firms are denoted as $N^{hd_{it}}$ and $N^{ld_{it}}$ respectively. Debt issuance is calculated as the change in assets (at) minus the change in book equity (seq) from Compustat, scaled by lagged assets. A bond issuer's expected default frequency is computed following Merton (1974) and Bharath and Shumway (2008). IQ^{GH} compares the average EDF rank of issuers with high net debt (net debt issuance in the top quintile of the sample) to that of issuers with low net debt (net debt issuance in the bottom quintile of the sample). IQ^{GH} assesses the overall credit quality sentiment in both the loan and bond markets. Higher values of IQ^{GH} indicate a greater presence of debt issuers with poor credit quality, serving as a barometer for the issuer quality in the credit market.
RA^{BEX}	Time-varying risk aversion index obtained from Bekaert et al. (2022).
Firm Size ($MCAP$)	The market value of a firm's common equity (prc * shrout) at the end of each month. The market value of equity is measured in billions.
Bond Market β (β^{bond})	Estimated from the time-series regressions of individual excess bond returns on the bond market excess returns using a 36-month rolling window.
Asset Growth (AG)	The year-over-year percentage change in total assets (at) from the end of fiscal year $t-2$ to the end of fiscal year $t-1$ (Cooper, Gulen, and Schill, 2008).
Market-to-book Ratio (M/B)	The ratio of market value to book value of an asset, defined by dividing the sum of market capitalization and total assets minus the book value of equity by total assets.
Default Spread (DEF)	The difference between the monthly returns of long-term investment-grade bonds and long-term government bonds. The long-term investment-grade bond returns are based on a value-weighted portfolio that includes all investment-grade bonds in our sample with at least ten years to maturity. The weight is determined by the market value of a bond, which is the number of units outstanding times market price of the bond.
Term Spread ($TERM$)	The difference between the monthly return of the long-term government bond and the one-month T-bill rate.
Liquidity Risk Factor (LIQ)	Defined as the average return difference between the high liquidity beta portfolio (decile 10) and the low liquidity portfolio (decile 1). We estimate the liquidity beta over a five-year rolling window for each individual bond and then sort the individual bonds into ten decile portfolios each month by the preranking liquidity beta.

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Table 1: Summary Statistics

This table reports summary statistics for bond-month observations over the sample period from July 2002 to December 2020. The descriptive statistics include the sample mean, 25th percentile, median, 75th percentile, and standard deviation of the variables used in this study. The variables analyzed in this study include monthly excess bond returns (Excess Return, %), refinancing intensity (RI), as well as several firm characteristics, such as leverage (LEV) and return on equity (ROE). Bond characteristics include maturity in years (Maturity), credit rating (Rating), issuing amount (Issue Size, in billions), expected default frequency (EDF), Amihud illiquidity measure (ILQ^{Amihud}), Roll illiquidity measure (ILQ^{Roll}) and the dummy variable for callable bonds (Call). Variables are defined in the Appendix.

Variable	N	Mean	25th Pctl.	Median	75th Pctl.	Std. Dev.
Excess Return [in %]	296,864	0.45	-0.47	0.27	1.32	3.64
RI	296,864	0.27	0.16	0.24	0.35	0.16
LEV	296,864	0.32	0.23	0.31	0.40	0.12
ROE	296,864	0.15	0.06	0.12	0.21	0.27
Maturity	296,864	10.46	4.00	7.00	16.00	9.67
Rating	296,864	7.45	6.00	7.00	9.00	2.85
Issue Size [$Bil]	296,864	0.65	0.30	0.50	0.75	0.64
EDF	296,691	0.02	0.00	0.00	0.00	0.09
ILQ^{Amihud} [% in $Mil]	294,832	1.22	0.23	0.54	1.30	2.03
ILQ^{Roll} [%]	296,660	1.23	0.31	0.71	1.48	1.89
Call	296,864	0.80	1.00	1.00	1.00	0.40

Table 2: Debt Refinancing and Corporate Bond Returns

This table presents the panel regression results of monthly excess bond returns on refinancing intensity (RI) and leverage (LEV) over the sample period from July 2002 to December 2020. Panel A reports results of all levered firms while Panel B for a sample in which we exclude almost-zero-leverage (AZL) firms (All-but-AZL), defined as firms with a leverage ratio below 5%. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. The main variables of interest are RI and LEV. Firm and bond characteristic variables include return on equity (ROE), the natural logarithm of the maturity in years (Ln(Matuiry)), the natural logarithm of one plus credit rating (Ln(1+Rating)), and the natural logarithm of issue size (Ln(Issue Size)), return reversal (Reversal), Amihud illiquidity measure (Illiquidity) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

Panel A. All Levered Firms				
	(1)	(2)	(3)	(4)
RI	0.114**	0.117**	0.129**	0.165***
	(2.29)	(2.32)	(2.55)	(3.18)
LEV		0.130	0.144	-0.154
		(1.11)	(1.34)	(-1.45)
ROE			-0.326***	-0.280***
			(-4.71)	(-5.20)
Ln(Maturity)				0.170***
				(20.47)
Ln(1+Rating)				0.661***
				(8.99)
Ln(Issue Size)				0.039***
				(5.05)
Reversal				-0.062***
				(-5.31)
Illiquidity				0.116***
				(9.11)
Call				0.009
				(0.48)
Issuer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs.	296,864	296,864	296,864	294,832
$Adj.R^2$	0.025	0.025	0.026	0.040

Panel B. All but AZL				
	(1)	(2)	(3)	(4)
RI	0.149***	0.150***	0.164***	0.196***
	(2.68)	(2.69)	(2.94)	(3.37)
LEV		0.116	0.116	-0.171
		(0.93)	(1.02)	(-1.51)
ROE			-0.324***	-0.278***
			(-4.59)	(-5.02)
Ln(Maturity)				0.172***
				(21.15)
Ln(1+Rating)				0.689***
				(8.86)
Ln(Issue Size)				0.038***
				(4.96)
Reversal				-0.064***
				(-5.41)
Illiquidity				0.114***
				(9.30)
Call				0.010
				(0.51)
Issuer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs.	290,040	290,040	290,040	288,464
$Adj.R^2$	0.026	0.026	0.026	0.040

Table 3: The Effect of Default Risk on Debt Refinancing

This table presents the panel regression results of the effect of default risk on debt refinancing and corporate bond returns. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. The main variables of interest are interaction terms between default risk proxies and refinancing intensity (RI). A bond's default risk is proxied using two measures: expected default frequency and the bond's credit rating. The expected default frequency (EDF) is estimated based on methods proposed by Merton (1974) and Bharath and Shumway (2008). For each month, we classify bond issuers that fall within the top quintile as firms with a high expected default frequency (High EDF). We take the natural logarithm of credit rating (Ln(1+Rating)). High-yield bonds (HY) include bonds with ratings of BB+ or lower. Other firm characteristics include leverage (LEV) and return on equity (ROE). Bond characteristic variables include the natural logarithm of the maturity in years (Ln(Matuiry)), and the natural logarithm of issuer size (Ln(Issue Size)), return reversal (Reversal), Amihud illiquidity measure (Illiquidity) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

	Expected Default Frequency		Credit Rating	
	(1)	(2)	(3)	(4)
RI* EDF	1.365**			
	(2.14)			
RI* High EDF		0.227**		
		(2.09)		
RI* Medium EDF		0.179**		
		(2.11)		
RI* Ln(1+Rating)			0.428**	
			(2.24)	
RI * HY				1.187***
				(4.78)
RI	0.120**	0.014	-0.740*	-0.015
	(2.37)	(0.22)	(-1.91)	(-0.30)
EDF	-0.245			
	(-0.81)			
High EDF		0.037		
		(1.07)		
Medium EDF		-0.021		
		(-0.86)		
Ln(1+Rating)			0.508***	
			(5.91)	
HY				0.261***
				(3.18)
LEV	0.022	-0.040	-0.153	-0.098
	(0.23)	(-0.41)	(-1.43)	(-1.06)
ROE	-0.309***	-0.317***	-0.280***	-0.313***
	(-5.73)	(-5.77)	(-5.20)	(-5.83)
Ln(Maturity)	0.166***	0.166***	0.169***	0.167***
	(20.18)	(20.16)	(20.42)	(20.48)
Ln(Issue Size)	0.039***	0.039***	0.039***	0.043***
	(5.13)	(5.18)	(5.04)	(5.61)
Reversal	-0.062***	-0.062***	-0.062***	-0.062***
	(-5.26)	(-5.26)	(-5.31)	(-5.32)
Illiquidity	0.117***	0.117***	0.116***	0.116***
	(9.13)	(9.11)	(9.11)	(9.14)
Call	0.034*	0.037**	0.008	0.035*
	(1.79)	(2.00)	(0.41)	(1.84)
Issuer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs.	294,832	294,832	294,832	294,832
$Adj.R^2$	0.039	0.039	0.040	0.040

Table 4: The Effect of Liquidity Risk on Debt Refinancing

This table presents the panel regression results of the effect of liquidity risk on debt refinancing and corporate bond returns. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. The main variables of interest are interaction terms between liquidity risk proxies and relative intensity (RI). A bond's liquidity risk is assessed using two measures: the Amihud illiquidity measure (Amihud, 2002) and the Roll illiquidity measure (Roll, 1984; Dick-Nielsen, Feldhütter, and Lando, 2012). Further, at the end of each month, the sample is divided into terciles based on the Amihud illiquidity measure. The top tercile group, known as High ILQ, comprises the least illiquid bonds. The middle tercile group is known as Medium ILQ. Other firm characteristics include leverage (LEV) and return on equity (ROE). Bond characteristic variables include the natural logarithm of the maturity in years (Ln(Matuiry)), the natural logarithm of one plus credit rating (Ln(1+Rating)), and the natural logarithm of issue size (Ln(Issue Size)), return reversal (Reversal) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

	Amihud Illiquidity		Roll Illiquidity	
	(1)	(2)	(3)	(4)
RI * Illiquidity	0.242**		0.434***	
	(2.27)		(3.15)	
RI * High ILQ		0.240**		0.647***
		(2.10)		(4.03)
RI * Medium ILQ		0.099		0.140*
		(1.20)		(1.69)
RI	-0.121	0.046	-0.364*	-0.031
	(-0.94)	(0.66)	(-1.95)	(-0.37)
Illiquidity	0.049*		0.126***	
	(1.90)		(4.20)	
High ILQ		0.064*		-0.042
		(1.86)		(-0.93)
Medium ILQ		0.007		-0.055*
		(0.24)		(-1.94)
LEV	-0.164	-0.142	-0.350***	-0.110
	(-1.54)	(-1.33)	(-2.92)	(-0.89)
ROE	-0.275***	-0.294***	-0.251***	-0.315***
	(-5.11)	(-5.32)	(-3.63)	(-4.37)
Ln(Maturity)	0.168***	0.207***	0.084***	0.185***
	(20.41)	(23.97)	(6.19)	(18.98)
Ln(1+Rating)	0.649***	0.709***	0.563***	0.804***
	(9.09)	(9.14)	(7.04)	(9.65)
Ln(Issue Size)	0.044***	0.002	0.076***	-0.024*
	(5.37)	(0.33)	(6.32)	(-1.95)
Reversal	-0.063***	-0.062***	-0.117***	-0.106***
	(-5.40)	(-5.25)	(-8.80)	(-8.12)
Call	-0.008	-0.034*	0.037	-0.015
	(-0.36)	(-1.83)	(1.47)	(-0.62)
Issuer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs.	294,832	294,832	296,660	296,660
$Adj.R^2$	0.04	0.036	0.052	0.039

Table 5: Debt Refinancing and Bond Maturity

This table presents the panel regression results of the effect of bond maturity on debt refinancing and corporate bond returns. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. The main variables of interest are the interaction terms between relative intensity (RI) and bond maturity. Ln(Maturity) represents the natural logarithm of a bond's time to maturity in years. Long-term is a dummy variable that takes the value of 1 for bonds with a maturity of ten years or more. Medium-term is the dummy variable that takes the value of 1 for bonds with a maturity between five years and ten years. Firm characteristics include leverage (LEV) and return on equity (ROE). Bond characteristic variables include the natural logarithm of one plus credit rating (Ln(1+Rating)), and the natural logarithm of issue size (Ln(Issue Size)), return reversal (Reversal), Amihud illiquidity measure (Illiquidity) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)
RI * Ln(Maturity)	0.160**	
	(2.15)	
RI * Long-term		0.396**
		(2.32)
RI * Medium-term		0.000
		(0.00)
RI	-0.155	0.072
	(-0.89)	(1.10)
Ln(Maturity)	0.128***	
	(6.28)	
Long-Term		0.198***
		(4.92)
Medium-Term		0.143***
		(6.67)
LEV	-0.151	-0.151
	(-1.42)	(-1.42)
ROE	-0.280***	-0.281***
	(-5.19)	(-5.20)
Ln(1+Rating)	0.653***	0.637***
	(9.00)	(8.79)
Ln(Issue Size)	0.039***	0.043***
	(5.10)	(5.44)
Reversal	-0.062***	-0.062***
	(-5.31)	(-5.30)
Illiquidity	0.115***	0.115***
	(9.13)	(9.11)
Call	0.004	0.026
	(0.19)	(1.32)
Issuer Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
No. of obs.	294,832	294,832
$Adj.R^2$	0.040	0.039

Table 6: Debt Refinancing and Credit Market Freezes

This table presents the panel regression results of the effect of debt refinancing and corporate bond returns during recession periods. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. The main variables of interest is the interaction term between *RI* and the recession dummies. The global financial crisis period (*GFC*) is defined as the period from December 2007 to June 2009, while the pandemic crisis period is defined from February to March of 2020. Other firm characteristics include leverage (LEV) and return on equity (ROE). Bond characteristic variables include the natural logarithm of the maturity in years (Ln(Matuiry)), the natural logarithm of one plus credit rating (Ln(1+Rating)), and the natural logarithm of issue size (Ln(Issue Size)), return reversal (Reversal), Amihud illiquidity measure (Illiquidity) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)
RI * GFC	1.330***	
	(3.87)	
RI * PC		6.653***
		(5.92)
RI	0.079*	0.093*
	(1.69)	(1.80)
GFC	0.077	
	(0.83)	
PC		-8.387***
		(-21.87)
LEV	-0.175	-0.119
	(-1.62)	(-1.13)
ROE	-0.271***	-0.277***
	(-5.04)	(-5.12)
Ln(Maturity)	0.172***	0.171***
	(20.73)	(20.82)
Ln(1+Rating)	0.654***	0.642***
	(9.13)	(8.80)
Ln(Issue Size)	0.038***	0.031***
	(5.01)	(4.09)
Reversal	-6.281***	-5.790***
	(-5.39)	(-5.04)
Illiquidity	0.113***	0.099***
	(9.12)	(7.88)
Call	0.011	-0.003
	(0.59)	(-0.16)
Issuer Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
No. of obs.	294,832	294,832
$Adj.R^2$	0.040	0.080

Table 7: Debt Refinancing and Interest Rate Environment

This table presents the panel regression results of the interaction effect of interest rate environment and debt refinancing on corporate bond returns. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. The main variables of interest are the interaction terms between *RI* and dummy variables representing various interest rate environments. $FFR \geq 2\%$ represents periods with federal fund rates of 2% or more. $FFR \geq 4.5\%$ represents periods with federal fund rates of 4.5% or more. *FFR Increase* represents periods with federal fund rate hikes. *Cum. FFR Inc. 25-100 bps* and *Cum. FFR Inc.*$>100bps$ represent periods with federal fund rate hikes of 25-100 bps and more than 100 bps, respectively, over the past 1-year period. Firm characteristics include leverage (LEV) and return on equity (ROE). Bond characteristic variables include the natural logarithm of the maturity in years (Ln(Matuiry)), the natural logarithm of one plus credit rating (Ln(1+Rating)), and the natural logarithm of issue size (Ln(Issue Size)), return reversal (Reversal), Amihud illiquidity measure (Illiquidity) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)
RI * FFR ≥ 2 %	0.240***			
	(2.87)			
RI * FFR ≥ 4.5 %		0.987***		
		(7.92)		
RI * FFR Increase			0.302***	
			(3.66)	
RI * Cum. FFR Inc. 25-100 bps				0.336***
				(3.65)
RI * Cum. FFR Inc. > 100 bps				0.536***
				(4.03)
RI	0.111**	0.118**	0.137**	0.125**
	(1.99)	(2.05)	(2.54)	(2.34)
FFR ≥ 2%	0.344***			
	(9.55)			
FFR ≥ 4.5 %		-0.339***		
		(-5.41)		
FFR Increase			-0.066**	
			(-2.26)	
Cum. FFR Inc. 25-100 bps				0.002
				(0.05)
Cum. FFR Inc. > 100 bps				-0.369***
				(-6.87)
LEV	-0.148	-0.156	-0.146	-0.141
	(-1.39)	(-1.47)	(-1.37)	(-1.33)
ROE	-0.274***	-0.280***	-0.281***	-0.281***
	(-5.09)	(-5.19)	(-5.21)	(-5.22)
Ln(Maturity)	0.170***	0.170***	0.170***	0.170***
	(20.50)	(20.44)	(20.45)	(20.42)
Ln(1+Rating)	0.660***	0.664***	0.662***	0.663***
	(8.97)	(9.09)	(8.99)	(9.00)
Ln(Issue Size)	0.038***	0.040***	0.039***	0.039***
	(4.96)	(5.15)	(5.08)	(5.10)
Reversal	-0.063***	-0.062***	-0.062***	-0.062***
	(-5.35)	(-5.32)	(-5.31)	(-5.31)
Illiquidity	0.116***	0.116***	0.116***	0.116***
	(9.16)	(9.09)	(9.10)	(9.09)
Call	0.009	0.007	0.009	0.008
	(0.48)	(0.38)	(0.45)	(0.43)
Issuer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs.	294,832	294,832	294,832	294,832
$Adj.R^2$	0.040	0.040	0.040	0.040

Table 8: Debt Refinancing and Investor Sentiment

This table presents results of panel regressions examining the effect of investor sentiment on the debt refinancing risk premium. The dependent variable is a bond's future monthly return in excess of the one-month T-bill rate. Risk aversion is estimated using the risk aversion index developed by Bekaert, Engstrom, and Xu (2022) (RA^{BEX}). The second approach is the issuer quality measure introduced by Greenwood and Hanson (2013) (IQ^{GH}). We further define a period of high risk aversion (*High RA*) as one where the risk aversion index ranks within the top quintile of the previous month. Similarly, we define a period of low issuer quality (*Low IQ*) as one where the issuer quality measure falls within the bottom quintile for the preceding quarter. Both *High RA* and *Low IQ* signify periods characterized by low investor sentiment. The main variables of interest is the relative intensity (RI) and its interaction with the two dummy variables. Other firm characteristics include leverage (LEV) and return on equity (ROE). Bond characteristic variables include the natural logarithm of the maturity in years (Ln(Matuiry)), the natural logarithm of credit rating (Ln(1+Rating)), and the natural logarithm of issuer size (Ln(Issue Size)), return reversal (Reversal), Amihud illiquidity measure (Illiquidity) and dummy variables for callable bond (Call). Variables are defined in the Appendix. Bond issuer and year fixed effects are included in all regressions and t-values based on standard errors clustered at the bond level are reported in parentheses. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)
RI * Ln (RA^{BEX})	0.836*			
	(1.71)			
RI * High RA		0.432***		
		(2.75)		
RI * Ln (1+ IQ^{GH})			-0.858***	
			(-2.94)	
RI * Low IQ				0.968***
				(2.76)
RI	-0.739	0.071	0.182**	0.123
	(-1.40)	(1.33)	(2.30)	(1.40)
Ln (RA^{BEX})	1.433***			
	(11.43)			
High RA		0.220***		
		(4.33)		
Ln (1+ IQ^{GH})			-1.223***	
			(-13.37)	
Low IQ				0.660***
				(6.19)
LEV	-0.138	-0.153	-0.576***	-0.579***
	(-1.30)	(-1.44)	(-3.10)	(-3.14)
ROE	-0.260***	-0.272***	-0.318**	-0.309**
	(-4.85)	(-5.06)	(-2.32)	(-2.27)
Ln(Maturity)	0.174***	0.170***	0.028	0.018
	(21.10)	(20.49)	(1.34)	(0.86)
Ln(1+Rating)	0.633***	0.653***	1.071***	1.061***
	(8.92)	(8.96)	(7.18)	(7.14)
Ln(Issue Size)	0.034***	0.038***	0.072***	0.081***
	(4.48)	(4.93)	(3.55)	(3.94)
Reversal	-0.057***	-0.062***	-0.110***	-0.110***
	(-4.94)	(-5.31)	(-6.16)	(-6.12)
Illiquidity	0.103***	0.113***	0.072***	0.079***
	(8.28)	(8.93)	(5.11)	(5.55)
Call	0.006	0.008	0.065**	0.067**
	(0.33)	(0.41)	(2.15)	(2.23)
Issuer Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs.	294,832	294,832	294,832	294,832
$Adj.R^2$	0.043	0.040	0.060	0.054

Table 9: Portfolio Characteristics Sorted by Rating, Maturity, and Refinancing Intensity

This table summarizes the characteristics of portfolios from independent 2×3×3 sorts on rating, maturity, and refinancing intensity (RI). Each month, we use bond rating to split the bonds into two groups, investment grade (IG) and high-yield grade bonds (HY); independently, to sort bonds into three maturity groups, short-term, medium-term and long-term bonds; and independently, to sort bonds into three RI groups, for the low 30%, middle 40% and high 30% of the ranked RI. Taking the intersections of the two rating, three maturity, and three RI groups, we compute the monthly average characteristics of the $2\times3\times3 = 18$ portfolios. IG (HY) are the average characteristics of the nine investment-grade (high-yield) portfolios. Short-term (Long-term) are the average characteristics of six short-term (long-term) portfolios of maturity. Low (High) are the average characteristics of six low (high) portfolios of RI. We report averages for rating, maturity, RI, market value of equity ($MCAP$), market to book (M/B), asset growth (AG), return on equity (ROE), bond market beta (β^{bond}), the Amihud illiquidity measure (Illiquidity), bond size, and equal-weighted (EW) and value-weighted (VW) excess returns. Variables are defined in the Appendix.

	Rating		Maturity		Refinancing Intensity(RI)	
	IG	HY	Short-Term	Long-Term	Low	High
Rating	6.85	12.98	9.89	9.92	10.23	9.68
Maturity (Years)	11.54	9.92	3.28	21.30	11.06	10.58
RI	0.27	0.27	0.28	0.27	0.11	0.45
MCAP [$ Bill]	66.68	10.17	37.37	44.11	24.53	52.08
LEV	0.30	0.39	0.35	0.35	0.34	0.35
M/B	3.15	2.16	2.75	2.47	2.68	2.76
AG	0.07	0.02	0.04	0.04	0.08	0.03
ROE	0.16	-0.04	0.06	0.04	0.07	0.10
β^{Bond}	1.24	1.27	0.84	1.69	1.28	1.21
Illiquidity	3.21	5.50	2.81	6.68	3.65	5.40
Bond Size [$ Bill]	0.69	0.43	0.55	0.53	0.52	0.60
Ret [EW in %]	0.42	0.81	0.44	0.83	0.57	0.67
Ret [VW in %]	0.43	0.82	0.41	0.77	0.55	0.63

Table 10: Spanning Tests of Return Differentials Associated with Refinancing Intensity against the Risk Factors

This table presents results for spanning regression of high-minus-low return differentials associated with refinancing intensity. We estimate refinancing risk premia from independent 2×3×3 sorts on rating, maturity, and refinancing intensity (RI). Each month, we use bond rating to split the bonds into two groups, investment grade and non-investment grade bonds; independently, to sort bonds into three maturity groups, short-term, medium-term and long-term bonds; and independently, to sort bonds into three RI groups, for the low 30%, middle 40% and high 30% of the ranked RI. Taking the intersections of the two rating, three maturity, and three RI groups, we compute the monthly equal-weighted and value-weighted returns of the 2×3×3=18 portfolios. Then we estimate the difference between the average returns on the six high and the six low RI portfolios. In the spanning regressions, we use the Fama and French (1993) three factors for specification (2) and (6), default and term spreads as well as liquidity factor for specification (3) and (7), and all six factors for specification (4) and (8). The t-statistics are based on HAC standard errors using Newey and West (1987) with optimal truncation lag chosen as suggested by Andrews (1991).

	Equal-Weighted Portfolios				Value-Weighted Portfolios			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.103**	0.086*	0.060	0.045	0.082**	0.063*	0.074	0.049
	(2.18)	(1.93)	(1.19)	(0.56)	(2.01)	(1.85)	(0.72)	(0.52)
MKT^{Stock}		0.062		0.007		-0.001		-0.047
		(0.97)		(0.16)		(-0.04)		(-1.10)
SMB		0.046		0.048		0.032		0.039
		(0.94)		(0.84)		(0.82)		(0.81)
HML		0.079		0.084		0.034		0.046
		(0.86)		(0.76)		(0.51)		(0.55)
DEF			0.209*	0.154*			0.125*	0.168*
			(1.92)	(1.79)			(1.79)	(1.83)
$TERM$			0.005	0.006			0.015	0.015
			(0.11)	(0.17)			(0.55)	(0.66)
LIQ			0.413**	0.418**			0.248**	0.246**
			(2.28)	(2.25)			(2.15)	(2.07)

Figure 1: U.S. Corporate Short-term Debt Maturing from 2001 to 2020

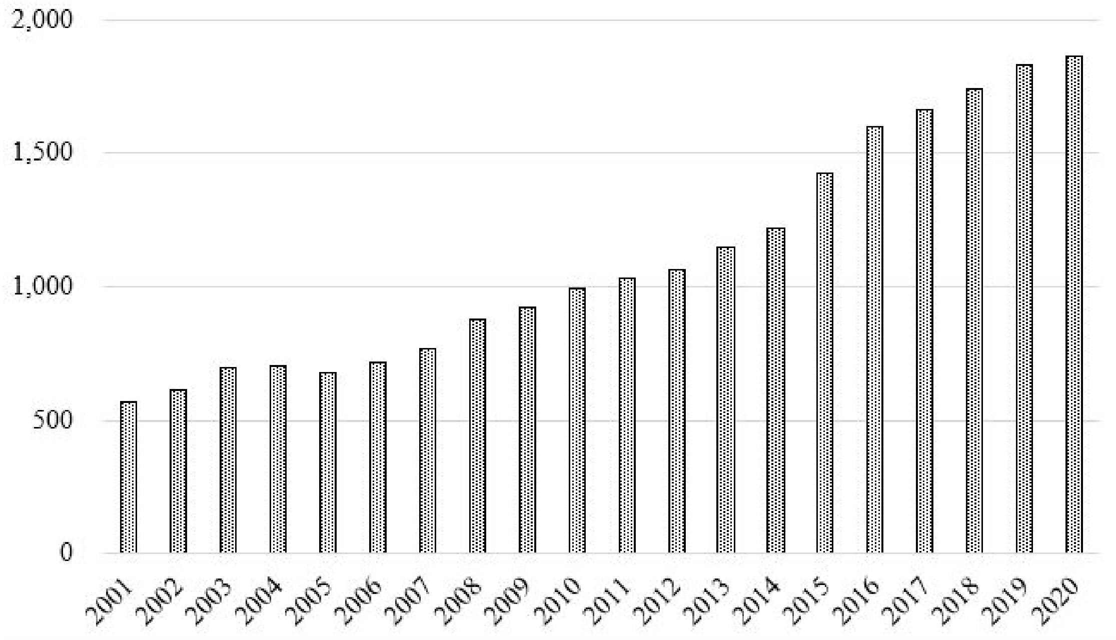

Figure 1 portrays the maturing trends of corporate debt for all U.S. corporations between the years 2001 and 2020, with a specific focus on debt that matures within a 1 to 3-year time frame. The data is represented in billions of U.S. dollars, and the graph visually illustrates how the amount of corporate debt maturing within this duration has evolved over the past two decades. Each year is plotted along the x-axis, while the corresponding amount of debt is displayed on the y-axis.