The Cross-Section of Credit Risk Premium and Corporate Bond Returns

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Abstract

Friewald, Wagner, and Zechner (2014) document a positive relationship between stock returns and credit risk premiums. This paper examines the role of credit risk premiums in the cross-section of expected corporate bond returns using four CDS premium measures over the period of 2002-2016. We find that bonds with a high credit risk premium are compensated with higher expected returns. The return predictive power of credit risk premium concentrates in the short horizon and is stronger for bonds with a smaller issue amount, lower credit ratings, and longer maturity. Credit risk premium contains information beyond conventional risk factors and bond characteristics.

JEL classification: G12; G13

Keywords: Credit risk premium; CDS spreads; expected bond returns; bond characteristics

1. Introduction

Firm's default risk and its relationship to asset prices are subjects of considerable interest in finance. Rational theory suggests that default risk should be compensated by a risk premium. However, the literature has documented a distress puzzle that stocks with high distress risk have anomalously low returns. Numerous papers have proposed different measures of default risk and tested the relation between the default risk and returns. Using firm-specific measures of credit risk premium estimated from the CDS forward curve by the method of Cochrane and Piazzesi (2005), Friewald, Wagner and Zechner (2014) find that firms' stock returns increase with the credit risk premium. Existing studies on the role of credit risk premiums in asset pricing have focused on stock. This issue is considerably underexplored for corporate bonds. Our paper contributes to the literature by providing new evidence on the role of the credit risk premium in the pricing of corporate bonds.

Empirical evidence on the relationship between default risk and return is mixed. A number of papers have shown that firm's default risk is negatively related to its equity returns, a phenomenon dubbed "distress anomaly" or the "distress puzzle" in the literature. Using Altman (1968) Z-score and the Ohlson (1980) O-score to measure default risk, Dichev (1998) reports a negative relation between firm's default risk and stock returns. Using a dynamic panel regression approach that incorporates accounting and market data, Campbell, Hilscher and Szilagyi (2008) find that firms with high distress risk deliver abnormally low returns. Avramov, Chordia, Jostova and Philipov (2009) find that the distress puzzle is most pronounced for worst-rated stocks around rating downgrades.

However, some studies have documented counter evidence. Using the Merton (1974) model, Vassalou and Xing (2004) construct a market-based measure for default risk and conclude that distressed stocks have higher returns. Based on the implied cost of capital, Chava and Purnanandam (2010) estimate expected returns and find that they are positively related to default risk. On the other hand, using corporate yield spreads to measure risk-neutral default probabilities, Anginer and Yildizhan (2010) find that firm's default risk is not priced in equity markets. Also, they find no evidence that firms with high distress risk earn anomalous low returns.

Given the controversial empirical findings, several theoretical models have been proposed to explain the different effects of firm's default risk equity returns. These include models shareholder recovery (e.g., Garlappi, Shu and Yan (2008), Garlappi and Yan (2011)), exposure to systematic risk (e.g., Ozdagli (2013)), or long-run risk (e.g., Avramov, Cederburg and Hore (2012)).

Another strand of research explore the relation between equity and CDS markets. Acharya and Johnson (2007) find that an increase in CDS spreads predict negative stock returns. Ni and Pan (2015) show that stock returns become predictable in the presence of short-sale bans as the negative information in the CDS market is impounded into equity prices slowly. Han, Subrahmanyam and Zhou (2017) find that the slope of the term structure of CDS spreads negatively predicts stock returns. Campello, Chen and Zhang (2008) construct firm-specific measures of expected equity returns using corporate bond yield spreads, recovery rates, and default transition matrices. Merton's (1974) structural model predicts that the risk premium on equity and credit instruments are related because all claims on the same assets must be compensated by the same amount of return per unit of risk. Based on Merton (1974) model, Friewald, Wagner and Zechner (2014) explore the link between stock returns and credit risk. Berndt, Douglas, Duffie and Ferguson (2018) measure the credit risk premium using prices for bearing corporate default risk in excess of expected default losses and find that credit risk premium co-moves with macroeconomic indicators.

Following Bharath and Shumway (2008), we calculate the naïve distance to default and apply it to the Merton (1974) model to obtain a firm's probability to default. With the default probability estimate, we then follow Friewald, Wagner and Zechner (2014) to construct firm-specific measures of credit risk premium from the term structure of CDS spreads, similar to the approach of Cochrane and Piazzesi (2005). Finally, we study whether the measures of credit risk premium are priced in corporate bonds.

For each month, we first form five portfolios based on each of the four measures of firms' credit risk premium constructed from CDS spreads: credit risk premium ($\widehat{RP}$), relative credit risk premium ($\widehat{rel.RP}$), CDS-implied market price of risk ($\widehat{MPR}$), and equity risk premium ($\widehat{ERP}$). We report the equal-weighted average returns of the quintile portfolios. To see if return spreads can be explained by conventional risk factors, we run the Black-Jensen-Scholes (1972, BJS) time-series regression of portfolio returns using the Bai-Bali-Wen (2019, BBW) four-factor model for the bond market and FF-BBW nine-factor model for bond and stock markets. The four factors of Bai, Bali and Wen (2019) for the bond market Bond Market, Downside Risk, Credit Risk, and Liquidity Risk. The nine factors of the FF-BBW model include Fama and French (2015) five factors (*MKT*, *SMB*, *HML*, *RMW*, and *CMA*) and Bai, Bali and Wen (2019) four bond market factors.

The portfolio analysis shows that expected returns increase monotonically with the credit risk premium. Bonds with a high credit risk premium outperform those with a low credit risk premium by 0.371% (0.301%, 0.307%, 0.323%) per month when sorted by $\widehat{RP}$ ($\widehat{rel.RP}$, $\widehat{MPR}$, $\widehat{ERP}$). All the high-low portfolios return spreads are significant at the 1% level. The long-short portfolio alphas are all positive and significant. Portfolio return spreads are significant even after adjusting for conventional bond and stock market risk factors.

Gebhardt, Hvidkjaer and Swaminathan (2005) show that bond characteristics such as maturity, coupon, age, and ratings can explain the cross-section of corporate bond returns. We investigate whether the positive relationship between credit risk premium and future bond returns is robust to controlling for bond characteristics. Bivariate portfolio sorts show that the credit risk premium continue to show predictive power for future bond returns after controlling for bond characteristics. The predictive power of credit risk premium is stronger among bonds with smaller issue amount, lower credit ratings and longer maturity.

Cross-sectional regression tests show that the credit risk premium is an important factor in the pricing of corporate bond. This result hold even after controlling for the effects of conventional market factors and bond characteristics. The positive relation between the credit risk premium and expected returns is stronger for bonds with smaller issue amount, lower credit ratings and longer maturity. In addition, the relation is stronger in the high sentiment period and pre-crisis period.

Our paper contributes to the literature in two major ways. First, we show that the credit risk premium extracted from CDS spreads are priced in the corporate bond market. Our results expand the finding of Friewald, Wagner and Zechner (2014) to a different market and suggest that the same credit risk factor that is priced in the stock market is also price in the corporate bond market. Recently, a number of studies have investigated the role of stock market variables in the cross-section of bonds returns (see, for example, Bao and Hou (2017), Turan G, Avanidhar and Quan (2018), Choi and Kim (2018), Bai, Bali and Wen (2019)). Our study extend this literature to explore the link of the CDS market to the corporate bond market and show that the premium of credit risk derivatives explain the expected corporate bond return.

Second, the empirical evidence shows that the credit risk premiums estimated from CDS market have stronger predictive power for bonds with smaller issue amount, lower credit ratings and longer maturity. Previous studies show that bonds with smaller issue amount and lower credit ratings are more opaque. We find evidence that the credit risk premium in the CDS market plays a more important role for the pricing of these bonds. Thus, the CDS market conveys important information for opaque corporate bonds.

The remainder of the paper is organized as follows. Section II describes the data and estimation of the credit risk premium from the CDS forward spread. Section III discusses the empirical results. Finally, Section IV summarizes the findings and concludes the paper.

2. Data and credit risk premium

We obtain daily CDS spreads for USD-denominated contracts of the U.S. based obligors from Markit for the period from January 1, 2001 to December 31, 2016. We focus on the CDS with maturity of 1, 3, 5, 7, and 10 years as they are most frequently quoted and traded. The protection payment may be triggered by several different restructuring events, ranging from no restructuring to full restructuring. We include the contracts that adopt the modified restructuring (MR) clause, which was the market convention before the introduction of the CDS Big Bang protocol in April 2009, and the contracts that adopt the no-restructuring (NR) clause, which has been the market standard since the changes in the protocol took place. We use the last transaction data of the month to obtain the monthly CDS spreads. We calculate forward CDS spreads using the survival curve fitted to the CDS term structure. Feldhütter and Lando (2008) suggest that swap rates are the best parsimonious proxy for riskless rates. Therefore, we compute the discount factors from the interest rate swaps (with maturities of 1, 2, 3, 4, 5, 7, and 10 years) obtained from Board of Governors of the Federal Reserve system (FRED).

2.1 Estimation of the credit risk premium

Following Friewald, Wagner and Zechner (2014), we compute forward CDS spreads $F_t^{\tau\times T}$ from the following formula:

$$S_t^{\tau+T} \cdot RPV_t^{\tau+T} = S_t^{\tau} \cdot RPV_t^{\tau} + F_t^{\tau\times T} \cdot RPV_t^{\tau\times T} \tag{1}$$

where $\mathrm{S_t^T}$ is T–period spot CDS spread, $\mathrm{RPV_t^T}$ is the time-*t* present value of a credit-risky annuity, which is defined as

$$\begin{aligned} RPV_t^T \equiv \textstyle\sum_n^N \delta(t_{n-1}, t_n)\mathbb{E}_t^{\mathbb{Q}}\left[exp\left(-\int_t^{t_n}(r_s+\eta_s)ds\right)\right] \\ + \textstyle\sum_{n=1}^N \int_{t_{n-1}}^{t_n} \delta(t_{n-1}, u)\mathbb{E}_t^{\mathbb{Q}}\left[\eta_u\, exp\left(-\int_t^{u}(r_s+\eta_s)ds\right)\right]du\,. \end{aligned} \tag{2}$$

From the definition of RPV_t^T, we can get $RPV_t^{\tau\times T} = RPV_t^{\tau+T} - RPV_t^{\tau}$. Here, we use the notation $t_0 = t$ and $t_N = t + T$ with N referring to the number of premium payments during the life of the CDS contract. The term $\delta(t_{n-1}, t_n)$ refers to the day-count fraction between two consecutive premium payment dates t_{n-1} and t_n. For monthly data, $\delta(t_{n-1}, t_n) = \frac{1}{12}$. The riskless short rate r_s is the swap interest rate with a corresponding maturity. Default intensity η is estimated by the firm's probability of default based on Merton's (1974) distance to default (DD). we adopt the naïve distance to default (naïve DD) proposed by Bharath and Shumway (2008) as the DD measure:

$$naive\ DD = \frac{ln\left[\frac{E+F}{F}\right] + (r_{it-1} - 0.5\ naive\ \sigma_V^2)T}{naive\ \sigma_V\sqrt{T}} \tag{3}$$

The total volatility of the firm (σ_V) is approximated by

$$naive\ \sigma_V = \frac{E}{E+F}\sigma_E + \frac{E}{E+F}(0.05 + 0.25 * \sigma_E) \tag{4}$$

We obtain firms' stock and accounting information from CRSP and Compustat. Financial firms are excluded from the sample. The volatility of stock returns σ_E is the annualized standard deviation of returns estimated from the stock returns in the prior year. The market value of the firm E (in millions of dollars) is calculated as the product of share price at the end of the month and the number of shares outstanding. Following Vassalou and Xing (2004), we set the debt value (F) as the face value of current liabilities plus one-half of long-term debt. $\mathrm{r}_{\mathrm{it-1}}$ is the previous year stock return. Then, the naïve probability of default is estimated as $\pi_{\mathrm{naive}} = \mathcal{N}(-\text{naive DD})$, where $\mathcal{N}(\cdot)$ is the cumulative density function of the standard normal distribution. Figure 1 shows the time series of average naïve probability of default for the whole sample period (January 1970 to December 2017), which is similar to the Figure 1 in Vassalou and Xing (2004) but with a longer period. The shaded areas indicate recession periods as defined by the NBER. The figure shows that default probabilities vary with the business cycle and increase substantially during recessions.

[Insert Figure 1 around here]

Since we use the monthly data to calculate forward CDS spread, the default intensity η is estimated as $\eta_t = 1 - \left(1 - \pi_{naive,t}\right)^{1/12}$. We also assume that η and r_s remain constant from period *t* to *t*+*T*. Following Friewald, Wagner and Zechner (2014), we calculate the cross-maturity average of the observed CDS Sharpe ratios ($\overline{SR}_{t+\tau}$), CDS excess returns ($\overline{rel.RX}_{t+\tau}$), and excess changes ($\overline{RX}_{t+\tau}$) for contracts with maturities $T_k \in T = [1, 3, 5, 7]$ as

$$\overline{SR}_{t+\tau} \equiv \frac{1}{4}\sum_{T_k \in T} \frac{rel.RX_{t+\tau}^{T_k}}{SD_{t+\tau}}, \quad \overline{rel.RX}_{t+\tau} \equiv \frac{1}{4}\sum_{T_k \in T} rel.RX_{t+\tau}^{T_k}, \quad \overline{RX}_{t+\tau} \equiv \frac{1}{4}\sum_{T_k \in T} RX_{t+\tau}^{T_k} \qquad (5)$$

where $rel.RX_{t+\tau}^{T_k} \equiv logS_{t+\tau}^{T_k} - logF_t^{\tau \times T_k}$, $RX_{t+\tau}^{T_k} \equiv S_{t+\tau}^{T_k} - F_t^{\tau \times T_k}$, and $SD_{t+\tau}$ refer to the sample standard deviation of daily CDS spread returns between *t* and $t + \tau$.

For each of these cross-maturity averages, we estimate the common component across T_k by regressing $\overline{SR}_{t+\tau}$, $\overline{rel.RX}_{t+\tau}$, and $\overline{RX}_{t+\tau}$ on the term structure of forward CDS spreads. The firm's CDS term structure is defined as the current one-year CDS spread and forward CDS spreads of contracts starting in one, three, five, and seven years and effective for one year: $F_t = (1, S_t^1, F_t^{1\times1}, F_t^{3\times1}, F_t^{5\times1}, F_t^{7\times1})$. The corresponding vector of regression parameters is denoted by $\gamma^j = (\gamma_0^j, \gamma_1^j, \gamma_2^j, \gamma_3^j, \gamma_4^j, \gamma_5^j)$, where $j \in J = [SR, rel.RX, RX]$. Then, we estimate the firm's credit risk premium ($\widehat{RP}$), relative credit risk premium ($\widehat{rel.RP}$), CDS-implied market price of risk ($\widehat{MRP}$), and equity risk premium ($\widehat{ERP}$), which reflect time-*t* conditional expectations, using the following regressions.

$$\widehat{RP}_{t+\tau} = -(\gamma^{RX})^T F_t, \quad \widehat{rel.RP}_{t+\tau} = -(\gamma^{rel.RX})^T F_t,$$

$$\widehat{MPR}_{t+\tau} = -(\gamma^{SR})^T F_t, \; \widehat{ERP}_{t+\tau} = -(\gamma^{SR})^T F_t \cdot \hat{\sigma}_{E,t,\tau} \tag{6}$$

where $\hat{\sigma}_{E,t,\tau}$ denotes the time-t conditional equity volatility estimated as the standard deviation of daily equity returns from $t - \tau$ to t. We run the regressions using the information up to time *t* with a 60-month rolling window, and require each firm to have at least 10 months of data during the 60-month window.[1]

2.2 Corporate bond returns

Corporate bond data are obtained from the enhanced version of the Trade Reporting and Compliance Engine (TRACE) and Mergent's Fixed Investment Securities Database (FISD). The enhanced TRACE database contains price, time, and size of transactions from publicly traded over-the-counter corporate bonds starting from July 2002. The FISD database includes issuance information for all fixed-income securities that have a CUSIP or are likely to receive one soon. It contains issue- and issuer-specific information, such as coupon rate, issue date, maturity date, issue size, ratings, and other characteristics, for bonds maturing in 1990 or later.

We use bond characteristic information from FISD to identify and eliminate non-US dollar-

[1] We also run the regression using full-sample information following Cochrane and Piazzesi (2005), and the unreported results are similar.

denominated bonds and bonds backed by mortgages or other assets. To avoid confounding effects of embedded options (e.g., callable, puttable, convertible, and sinking funds), we focus on straight bonds only. We exclude bonds with a maturity of less than 1 year or longer than 30 years.

In addition, we follow the data screening procedure in Bessembinder, Kahle, Maxwell and Xu (2009) to eliminate canceled, corrected, commission, and small (below $100,000) trades. We also drop bonds whose ratings cannot be identified from the FISD. We employ primarily the Moody's rating, but use the Standard and Poor's (S&P) rating instead if Moody's rating is not available. We require bonds with at least 15-month transaction records for regression estimation. We match the firm's credit risk premium based on CDS spreads with corporate bond data from the Enhanced TRACE and FISD.

Our final sample includes 152,871 bond-month observations for 3,477 bonds issued by 1,007 firms from November 2002 to August 2016. Figure 2 plots the number of bonds and firms in each month. In our sample, both firm and bond numbers decline significantly during the subprime financial crisis period, and then slowly recover after that.

[Insert Figure 2 around here]

Following Bessembinder et al. (2009), we compute daily prices as the trade size-weighted average of intraday prices over the day and then use the month-end price to calculate returns,. The monthly corporate bond return at month *t* is computed as follows:

$$R_t = \frac{(P_t + AI_t) + C_t - (P_{t-1} + AI_{t-1})}{P_{t-1} + AI_{t-1}} \qquad (7)$$

where P_t is the transaction price, AI_t is accrued interest, and C_t is the coupon payment, if any, in month t. We use the last transaction price at the end of each month to calculate the monthly return for each bond. If the transaction does not fall in the last trading day of the month, we calculate the return by interpolating the last transaction price of the month with the first trading price in the next month.

We include several bond characteristics as control variables in our empirical analysis. *Size* is the logarithm of offering amount of the bond. *Rating* is the numerical indicator of the bond's credit rating.[2] *Maturity* is the time to maturity of the bond (in years) and *Age* is the number of years since the bond issuance.

We include the Fama-French three factors[3] (*Market*, *SMB*, and *HML*), term and default spread in the factor model of corporate bonds. 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 with at least ten years to maturity where the weight is the market value 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, both obtained from the FED. We also obtain liquidity innovations following the method of Lin, Wang and Wu (2011) using the Amihud (2002) liquidity measure. A credit risk premium factor is the equal-weighted average of the credit risk premiums of all firms matched with TRACE data at each month:

$$CRP_t = \frac{1}{N_t}\sum_{i=1}^{N_t} \widehat{RP}_{i,t} \ , \qquad rel.RP_t = \frac{1}{N_t}\sum_{i=1}^{N_t} \widehat{rel.RP}_{i,t}$$

$$MPR_t = \frac{1}{N_t}\sum_{i=1}^{N_t} \widehat{MPR}_{i,t} \ , \quad ERP_t = \frac{1}{N_t}\sum_{i=1}^{N_t} \widehat{ERP}_{i,t} \qquad (8)$$

where N_t is the number of bonds with a credit risk premium in month t. Figure 3 plots the time series of the four credit risk premium factors. The four risk premium factors co-move with each other, and all increase dramatically during the 2008 financial crisis.

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[2] Ratings are transformed into numerical scores as follows: Aaa=0, Aa+=1, AA=2, . . .,C=20, and D=21.
[3] The Fama-French three factors (*Market*, *SMB* and *HML*) are retrieved from French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html.

[Insert Figure 3 around here]

Panel A in Table 1 reports summary statistics for bond characteristics. For the full sample, the average coupon rate, maturity, and rating score are 6.06%, 6.99 years, and 5.99 (A-), respectively. The average bond age is 6.02 years, and the logarithm of offering amount (*Size*) is 12.90. We use these bond characteristics as control variables in empirical analysis.

Panel B of Table 1 shows the summary statistics of the risk factors used in asset pricing tests. Over the sample period, the monthly average of *CRP*, *rel.RP*, *MPR*, and *ERP* are 0.33, 9.20, 283.00 and 6.75, respectively. Average monthly stock market return is 0.74% and volatility (standard deviation) is 4.13%. The mean monthly returns of *SMB* and *HML* factors are 0.24% and 0.06%, respectively. The mean monthly term premium is 2.04% and the average monthly default premium is 1.11%. The Amihud bond market liquidity measure has mean close to zero as they are innovations by construction.

In Panel C of Table 1, we report the correlations among risk factors. The credit risk premium factor and *DEF* are correlated, as both reflect the market default risk premium. Our tests below show that the credit risk premium factors contain additional information beyond *DEF*. The correlations between the credit risk premium factors and other factors are quite low.

[Insert Table 1 around here]

3. Credit risk premium and cross-section of corporate bond returns

The literature suggests that several factors are important for bond pricing. Fama and French (1993) document that term and default factors are priced in corporate bonds while Elton, Gruber, Agrawal and Mann (2001) show that the Fama and French (1993) three factors are priced. Lin, Wang and Wu (2011) find that marketwide liquidity is also a pricing factor for corporate bonds. It is important to control for these factors to evaluate the effect of the credit risk premium factor on bond returns. We adopt the following multi-factor model to estimate betas:

$$r_{it} - r_{ft} = \alpha_i + \beta_{iRP} RP_t + \beta_{iMKT} MKT_t + \beta_{iSMB} SMB_t + \beta_{iHML} HML_t + \beta_{iDEF} DEF_t + \beta_{iTERM} TERM_t + \beta_{iLIQ} LIQ_t + \varepsilon_{it} \quad (9)$$

The dependent variable is bond returns in excess of the one-month T-bill rate. RP_t is the credit risk premium factor which can be *CRP*, *rel.RP*, *MPR*, or *ERP*; MKT_t is the stock market excess return; SMB_t is the size factor; HML_t is the book-to-market factor; DEF_t is the default spread; $TERM_t$ is the term spread; and LIQ_t is the liquidity factor based on Amihud (2002) liquidity measure.

Table 2 reports the full-period monthly average of bond excess returns and estimates of betas associated with the credit risk premium factors, Fama and French (1993) five factors, and liquidity factor. The bond monthly average excess return is 0.40%, and its standard deviation is 1.91%. We run the time series regression with the four credit risk premium measures separately. The loadings are 0.37, 0.02, 0.03, and 0.06 for *CRP*, *rel.RP*, *MPR*, and *ERP*, respectively. The betas of conventional risk factors are not sensitive to the inclusion of the credit risk premium factor in the model, except for *DEF* which is highly correlated with the credit risk premium factors.

[Insert Table 2 around here]

3.1. Univariate Portfolio Analysis

We begin with a portfolio analysis to examine whether expected bond returns are related to sensitivities to the credit risk premium (see Daniel and Titman (1997)). We first sort bonds into five portfolios at the beginning of each month according to firm's credit risk premium ($\widehat{RP}_t$, $\widehat{rel.RP}_t$, $\widehat{MRP}_t$, or $\widehat{ERP}_t$). The holding period for the bonds is one month and portfolios are rebalanced monthly. P.L contains bonds with the lowest credit risk premium and P.H contains bonds with the highest credit risk premium. We report the equally-weighted average returns of the quintile portfolios. Table 3 shows that portfolio returns increase with credit risk premium ($\widehat{RP}_t$, $\widehat{rel.RP}_t$, $\widehat{MRP}_t$, or $\widehat{ERP}_t$) monotonically. The difference in average monthly excess return between the highest and lowest credit risk premium ($\widehat{RP}_t$, $\widehat{rel.RP}_t$, $\widehat{MRP}_t$, or $\widehat{ERP}_t$) portfolios are 37.1 bps (t=3.89), 30.1 bps (t=4.74), 30.7 bps (t=4.23), and 32.3 bps (t=3.91), respectively. All t-statistic are based on heteroscedasticity and autocorrelation consistent standard errors using the method of Newey and West (1987).

[Insert Table 3 around here]

To examine whether the return spreads of the portfolio can be explained by conventional risk factors of the bond and stock markets, we run the Black-Jensen-Scholes (1972, BJS) time-series regression of portfolio returns against BBW bond market four-factor model[4] and FF-BBW9 bond and stock market nine-factor model. The FFBai9 bond and stock market nine-factor model combines the Bai, Bali and Wen (2019) bond market four factors and Fama and French (2015) five factors (*MKT, SMB, HML, RMW*, and *CMA*). The results show that alphas increase with the credit risk premium. For the four credit risk premium measures, the long-short (H-L) portfolio alphas range from 16.8 bps to 20.4 bps when alphas are estimated using Bai, Bali and Wen (2019) bond market four-factor model, and from 16.1 bps to 20.4 bps when alphas are estimated using FF-BBW9 model. All alphas for H-L portfolios are significantly positive.

3.2. Cross-sectional regression tests

The portfolio analysis shows that bonds with high credit risk premium ($\widehat{RP}_{\mathrm{t}}$, $\widehat{rel.RP}_{\mathrm{t}}$, $\widehat{MRP}_{\mathrm{t}}$, or $\widehat{ERP}_{\mathrm{t}}$) have high expected returns. Cross-sectional variations in bond returns exhibit a monotonic relation with credit risk premium that is robust to conventional risk factors of bond and stock market. These results suggest that the credit risk premium is a priced risk factor in the

[4] The bond market four factors are downloaded from Bali's Website: http://faculty.msb.edu/tgb27/index.html

corporate bond market. To substantiate this hypothesis, we first construct marketwide credit risk premium factor as an equal-weighted average of the credit risk premiums of all firms. We then perform Fama-MacBeth (1973) cross-sectional regressions to test whether the marketwide credit risk premium factor are indeed priced in the corporate bond market. In equilibrium, expected returns of corporate bonds should be related to factor loadings cross-sectionally. For the full model consists of all risk factors, the equilibrium relation is represented by the following cross-sectional regression:

$$\begin{aligned} r_{it} - r_{ft} &= \alpha_i + \gamma_{RP}\beta_{iRP} + \gamma_{MKT}\beta_{iMKT} + \gamma_{SMB}\beta_{iSMB} + \gamma_{HML}\beta_{iHML} \\ &+\gamma_{DEF}\beta_{iDEF} + \gamma_{TERM}\beta_{iTERM} + \gamma_{LIQ}\beta_{iLIQ} + Characteristics_i + u_i \end{aligned} \quad (10)$$

where γ_x is the price of risk factor x and RP stands for the marketwide credit risk premium factors: *CRP*, *rel.RP*, *MPR*, or *ERP*. Besides conventional risk factors, we consider bond characteristics, such as size, maturity, age, coupon, and rating, to evaluate the importance of credit risk premium factors relative to other risk factors and bond characteristics. We adjust the t-statistics based on heteroscedasticity and autocorrelation consistent standard errors using the method of Newey and West (1987). According to previous portfolio analysis results, we expect γ_{RP} to be significantly positive if the credit risk premium factors are priced in the corporate bond market.

Betas are first estimated over rolling past five-year periods for each bond and then used in the cross-sectional regression in the following month. We estimate betas for each corporate bond that has at least 15 monthly returns over the 60-month rolling window. For ease of interpretation for regression coefficients, each explanatory variable is normalized by its cross-sectional standard deviation every month. The resulting coefficients represent the impact per unit standard deviation of each variable on expected bond returns. The normalization makes it easier to compare the relative importance of different variables.

Table 4 reports the results of cross-sectional regressions on a credit risk premium factor, multi-factor regression with FF five factors, the FF5 with the liquidity factor, as well as controls for bond characteristics. The average coefficients of univariate regression on betas of *CRP*, *rel.RP*, *MPR*, and *ERP* are 0.057 (t=3.15), 0.060 (t=2.25), 0.067 (t=2.39), and 0.045 (t=2.16), respectively. The result suggest that the credit risk premium factor is priced in the corporate bond market. When including the conventional risk factors and bond characteristics, the four credit risk premium betas continue to be positive and significant at the 1% level in all model specifications. Controlling for the credit risk premium factor, *DEF* beta is not significant in all the regressions, suggesting that the credit risk premium factor captures most information related to the default premium.[5] Consistent with the literature, coefficients for term and liquidity are positive. Results show that the credit risk premium factor contains additional information beyond conventional risk factors and bond characteristics for the pricing of corporate bonds.

[Insert Table 4 here]

3.3. Robustness of portfolio analysis

The univariate portfolio analysis shows a strong positive relationship between the credit risk premium and future bond returns. However, the univariate relation could be confounded by the correlation of the credit risk premium with bond characteristics. Prior research shows that bond characteristics can explain cross-sectional variations in bond returns (Gebhardt, Hvidkjaer, and Swaminathan, 2005; Li et al., 2009) because they capture missing risk factors. As these characteristics are related to liquidity or default risk, they often have explanatory power for bond returns. Avramov, Chordia, Jostova and Philipov (2013) show that credit risk has direct implications for asset pricing. Bonds with lower ratings should be more sensitive to the credit

[5] To avoid the problem multi-collinearity, we also run a regression of *DEF* on *RP* and use the residual instead of *DEF* in the cross-sectional regression. Unreported results show that γ_{RP} remains significantly positive.

risk factor as these bonds are closer to the default boundary. To assess the robustness of our results, we control for the cross-sectional effects due to bond characteristics.

At each month, we first sort bonds into three or two portfolios based on bond characteristics, such as size, maturity, and rating. Within each portfolio, we further sort bonds into three groups based on the credit risk premiums. After forming the 3 x 3 or 2 x 3 characteristic and credit risk premium portfolios, we average the return of each credit risk premium groups across the characteristic portfolios. The resulting credit risk premium portfolios have an effective control for the difference in each characteristic. After controlling for each characteristic, we report long-short portfolio returns to check the robustness of the credit risk premium effect to each bond characteristic.

Panel A of Table 5 reports average return spreads between the highest and lowest credit risk premium portfolios. Average long-short portfolio returns are all positive and significant at the 1% level after controlling for bond characteristics such as issue size, maturity and rating. Results show that bond characteristics cannot explain the credit risk premium effect.

The long-short portfolio returns range from 27.6 bps to 39.4 bps for small issue size group, while those for large issue size group only range from 14.2 bps to 30.6 bps. A similar pattern can be found for long maturity bond (30.8 bps ~ 45.9 bps) vs. short maturity bond group (14.4 bps ~ 20.5 bps), and high-yield bond group (46.5 bps ~ 55.6 bps) vs. investment grade bond group (13.8 bps ~ 20.5 bps). These results indicate that the return predictive power of credit risk premium is stronger among bonds with more information asymmetry, such as smaller issue amount, lower credit ratings and longer maturity.

We also run the Black-Jensen-Scholes (1972, BJS) time-series regression for the bivariate sorted portfolio returns against BBW four-factor model and FF-BBW nine-factor model. The alpha estimates suggest that the credit risk premium factor is priced in corporate bonds, and abnormal returns are higher for bonds with smaller issue amount, lower credit ratings and longer maturity.

[Insert Table 5 here]

We next run the Fama-MacBeth cross-sectional regressions of multi-factor model for the subsamples divided by bond characteristics. Panel B of Table 5 shows that credit risk premium betas are positive and significant. There is a pattern that these betas decrease monotonically with issue size and increase with maturity. The betas are larger for high-yield bonds than for investment-grade bonds. The results again suggest that the credit risk factor is priced in corporate bonds, and this pricing effect is stronger for bonds with smaller issue amount, longer maturity and lower credit ratings.

3.4. Longer holding horizons

In this subsection, we study the longer-term cross-sectional predictability of the credit risk premium for corporate bond returns. For each month, we form portfolios by the credit risk premium, and hold these portfolios over the next two to four months. We then calculate the monthly average excess returns over different investment horizons.

Table 6 reports average monthly excess returns of the long-short credit risk premium portfolio and BBW and FF-BBW alphas. The results show that return predictability is short term. The predictive power is much weakened beyond the two-month horizon. This pattern is similar to the finding of An, Ang, Bali and Cakici (2014) that predictability of stock returns resulting from changes in implied volatility drops dramatically between the first and second months.

[Insert Table 6 here]

3.5. Additional tests

The analysis above shows the importance of the credit risk premium factor in corporate bond pricing. In this subsection, we conduct additional tests to check the robustness of our results.

3.5.1 Pre-crisis vs. Post-crisis period

We first test whether the credit risk premiums are priced in different subperiods. We divide the whole sample period into the pre-crisis period from November 2002 to June 2007, and the post-crisis period from June 2009 to August 2016. Again, we sort bonds into quintiles at each month by firm's credit risk premiums ($\widehat{RP}_t$, $\widehat{rel.RP}_t$, $\widehat{MRP}_t$, or $\widehat{ERP}_t$), and hold the portfolio for one month.

Panel A of Table 7 reports the average excess return spread between the highest and lowest credit risk premium quintiles and H-L portfolio alphas. All return spreads and alphas are significantly positive in both subperiods. The return spread and alphas in the post-crisis period are less than half of those in the pre-crisis period, which could be due to the regulatory reform after the financial crisis. Panel B of Table 7 presents the cross-section regressions of different model specifications. Betas of *CRP*, *rel.RP*, *MPR*, and *ERP* are significantly positive in both subperiods. The coefficients of betas are much smaller (around half) in post-crisis period than those in the pre-crisis period. The results show that the credit risk premium factor is priced both subperiods though the risk price may vary over time.

[Insert Table 7 here]

3.5.2 High vs. Low sentiment period

Hong and Sraer (2013) find that investor sentiment plays an important role in debt overpricing. They argue that holding the fundamental value cost, as investor sentiment rises, debt prices rise above fundamental value. Their finding suggests that the credit risk premium factor may play a different role as market sentiment varies. In this subsection, we investigate the performance of the credit risk premiums in different market sentiment periods.

Following Baker and Wurgler (2007), we use the Chicago Board Options Exchange (CBOE) Volatility Index (VIX) as the market sentiment measure. We divide our sample into low and high sentiment periods based on the sample median VIX and perform portfolio and regression analysis for both periods.

Panel A of Table 8 shows that the average long-short portfolio excess returns are positive and significant at 1% level for all four credit risk premiums. The BBW and FF-BBW alphas are also positive and significant in most cases. Return spreads and alphas are larger in the high-sentiment period than in the low-sentiment period.

Panel B shows cross-sectional regression results. The coefficients of the credit risk premium betas are significantly positive, even controlling other conventional risk factors and bond characteristics. The coefficients of credit risk premium betas are much larger in the high-sentiment period than in the low-sentiment period, consistent with the results in Panel A.

[Insert Table 8 here]

3.5.3 Sample aggregated at the firm level

There is substantial cross-sectional variations in the number of outstanding bonds issued by a firm. Some firms may issue only one bond, while others may issue hundreds. Bonds issued by the same firm are exposed to the same fundamental conditions, information flow and firm-specific risk. These bonds may exhibit a similar exposure to a firm's credit risk premium. Firms with multiple bonds could be over-weighted in the regressions and bias the cross-sectional relation between credit risk premiums and bond returns. To address this concern, we conduct tests on a sample at the issuer level. For each month, we calculate the equal-weighted average return of all available bonds issued by the same firm, and perform the cross-sectional regression analysis at the firm level.

Table 9 reports the results of cross-sectional regressions. The results show that all coefficients of the credit risk premium betas are positive and significant at the 5% level or better. The pattern of cross-section results are similar to that at the bond level. Thus, our results are robust to the sample at the bond or firm level.

[Insert Table 9 here]

4. Conclusion

This paper examines the effect of credit risk premiums on the pricing of corporate bonds over the period from 2002 to 2016. Following Friewald, Wagner and Zechner (2014), we estimate the credit risk premium from forward CDS spreads. For robustness, we use four measures of firm's credit risk premium. We find that the credit risk premium factor is priced in the cross-section of corporate bonds. This finding is robust to different measures of the credit risk premium.

Consistent with the finding Friewald, Wagner and Zechner (2014) for the stock market, credit risk premia are positively correlated with bond returns. Bonds with higher credit risk premiums have higher expected returns. This positive relation is robust to controlling for the effects of conventional risk factors, liquidity, and bond characteristics. The results suggest that credit risk premiums contain important information not captured by conventional risk factors and bond characteristics.

The effect of the credit risk premium varies across bonds of different characteristics. It is stronger for bonds with more information asymmetry, such as bonds with smaller issue amount, lower credit ratings and longer maturity. Empirical evidence suggests that there is more information spillover from CDS market to bond market for less transparent bonds. Overall, there is strong evidence that the credit risk premium is an important factor for the pricing of corporate bonds and the credit derivatives market provides more reliable information for the credit risk premium than the spot market.

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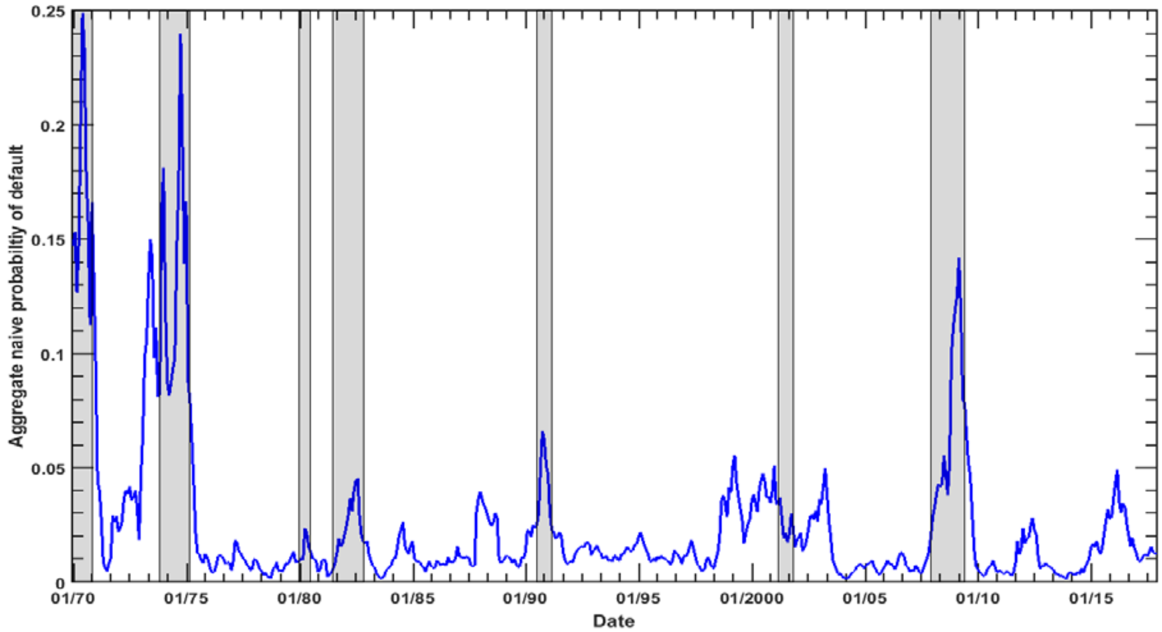

Figure 1. Aggregate naïve probability of default. The aggregate naïve probability of default is defined as the simple average of the naïve probability of default of all firms at each month. The shaded areas denote recession periods defined by NBER.

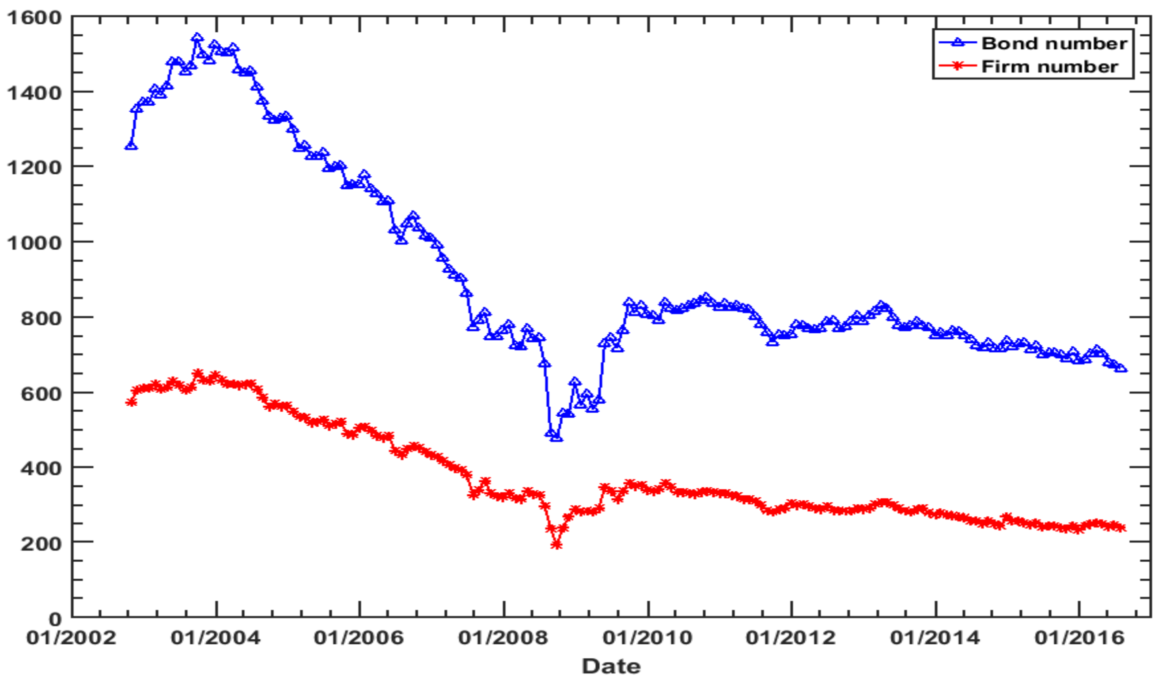

Figure 2. Numbers of bonds and firms for the full sample (2002-2016). This figure plots the number of bonds and firms in each month from November 2002 to August 2016.

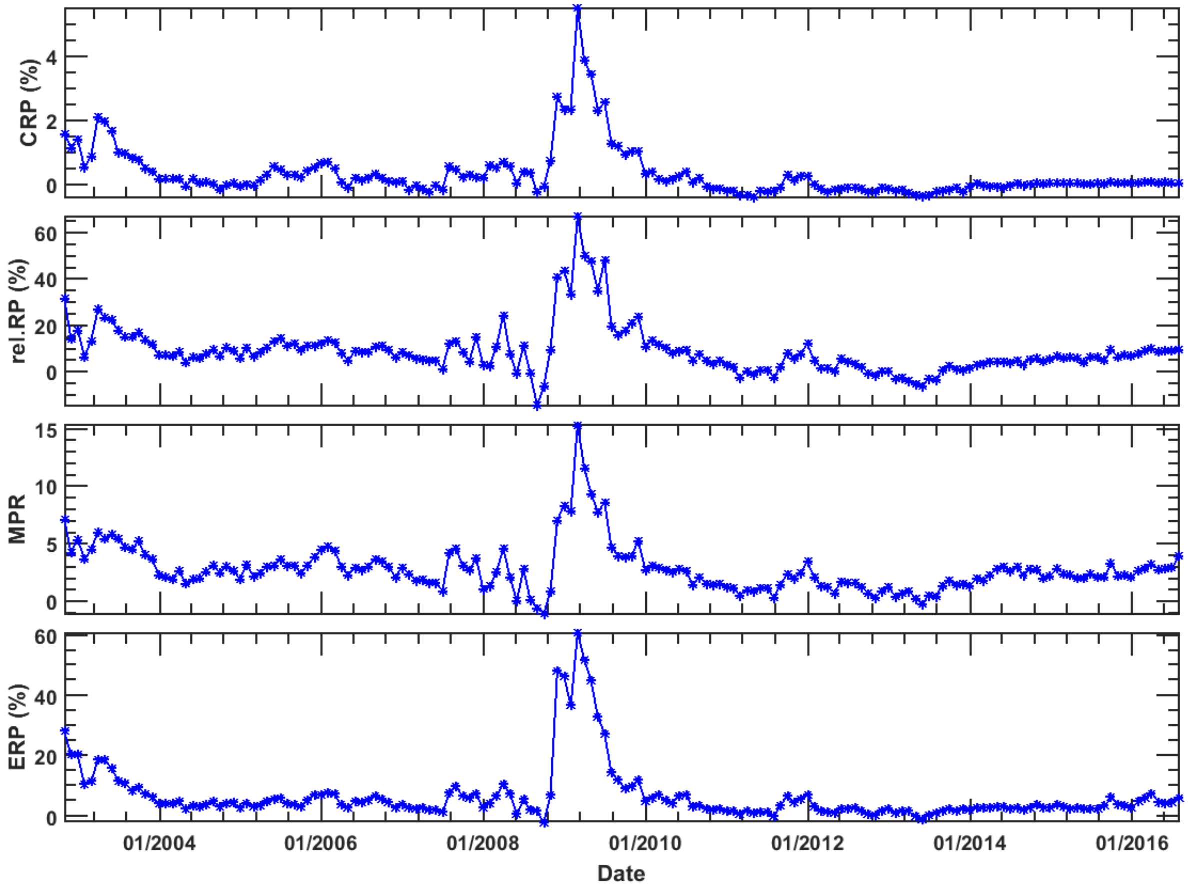

Figure 3. Marketwide credit risk premium factors. The marketwide credit risk premium factors are defined as a simple average of firm's credit risk premium ($\widehat{RP}$), its relative credit risk premium ($\widehat{rel.RP}$), its CDS-implied market price of risk ($\widehat{MRP}$), and its equity risk premium ($\widehat{ERP}$), in each month.

Table 1. Summary Statistics

This table summarizes the data used in our empirical analysis. Data are monthly and the sample runs from November 2002 to August 2016. Panel A reports the summary of corporate bond characteristics. *Rating* is the Moody's bond rating (Aaa = 0, Aa + = 1,…, C = 20, and D = 21), and if the Moody's rating is unavailable, we use the S&P rating whenever possible. *Size* is the logarithm of the offering amount; *Maturity* is years to maturity; *Age* denotes years since issuance; *Coupon* is the coupon rate. Panel B reports summary statistics for marketwide credit risk premium factors, *MKT*, *SMB*, *HML*, *DEF*, *TERM*, and liquidity for the full sample period. The marketwide credit risk premium factors *CRP*, *rel.RP*, *MPR*, and *ERP* are cross-sectional average of the firm's credit risk premium ($\widehat{RP}$), its relative credit risk premium ($\widehat{rel.RP}$), its CDS-implied market price of risk ($\widehat{MRP}$), and its equity risk premium ($\widehat{ERP}$), respectively. To get comparable betas, we report $\widehat{MRP}$ in raw data, while other factors in percentage. *MKT*, *SMB*, and *HML* are the Fama–French three factors downloaded from Kenneth French's data library. The *DEF* is the difference between the return of a value-weighted portfolio of long-term investment-grade bonds and the return of long-term government bonds. The *TERM* is the difference between the long-term government bond return and the one-month T-bill rate. All variables are expressed in percentage. Panel C reports the correlation among the risk factors.

Panel A: Bond Characteristics

Variable	Mean	Median	Minimum	Maximum	Std. Dev	Skewness
Size	12.90	12.83	8.54	15.89	0.92	-0.09
Maturity	6.99	4.38	1.00	30.00	6.58	1.62
Age	6.02	4.94	0.01	27.87	4.81	0.99
Coupon	6.06	6.25	0.60	13.25	1.79	-0.35
Ratings	5.99	5.00	0.00	21.00	3.74	0.97

Panel B: Summary statistics of factors

Variable	Mean	Median	Minimum	Maximum	Std Dev	Skewness
CRP	0.33	0.06	-0.41	5.48	0.80	3.26
rel.RP	9.20	7.12	-14.58	66.88	10.67	2.35
MPR	2.83	2.50	-1.10	15.33	2.09	2.33
ERP	6.75	4.00	-1.93	60.72	9.56	3.53
MKT	0.74	1.24	-17.23	11.35	4.13	-0.67
SMB	0.24	0.22	-4.29	6.11	2.25	0.12
HML	0.06	-0.13	-11.25	7.85	2.38	-0.34
DEF	1.11	0.97	0.55	3.38	0.48	2.78
TERM	2.04	2.22	-0.52	3.69	1.09	-0.70
LIQ	-0.01	0.07	-3.73	1.73	0.52	-2.51

Panel C: Factor correlations

	CRP	rel.RP	MRP	ERP	Market	SMB	HML	DEF	TERM
rel.RP	0.94								
MPR	0.92	0.96							
ERP	0.96	0.93	0.91						
Market	0.21	0.30	0.32	0.18					
SMB	0.21	0.21	0.22	0.19	0.39				
HML	0.03	0.01	0.04	-0.04	0.28	0.10			
DEF	0.68	0.60	0.50	0.73	-0.13	0.06	-0.16		
TERM	0.20	0.14	0.09	0.19	0.03	0.10	0.00	0.19	
LIQ	0.05	0.16	0.15	0.10	0.35	0.07	0.00	-0.05	-0.04

Table 2. Summary of time series regression estimates

This table reports summary statistics of the time series regression using the full sample. Data are monthly and the full sample runs from November 2002 to August 2016. Betas are estimated from the following multi-factor model:

$$r_{it}^{e} = \alpha_i + \beta_{iRP}RP_t + \beta_{iMKT}MKT_t + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + \beta_{iDEF}DEF_t + \beta_{iTERM}TERM_t + \beta_{iEILLIQ}EILLIQ_t + \varepsilon_t$$

where r_{it}^{e} is the individual bond excess return; RP_t is the credit risk premium factors and stands for *CRP*, *rel.RP*, *MPR*, or *ERP*; MKT_t is the stock market excess return; SMB_t is the size factor; HML_t is the book-to-market ratio; DEF_t is the default spread; $TERM_t$ is the term spread; LIQ_t is the liquidity factor based on Amihud (2002) liquidity measure. *MKT*, *SMB*, and *HML* are the Fama–French three factors downloaded from Kenneth French's data library. The default factor (*DEF*) is the difference between the return of a value-weighted portfolio of long-term investment-grade bonds and the return of long-term government bonds. The term factor (*TERM*) is the difference between the long-term government bond return and the one-month T-bill rate. *Return* is the monthly average of bond excess return in percentage terms. Betas are the full-period estimates by individual bonds.

	Mean	Median	Std.Dev	Mean	Median	Std.Dev	Mean	Median	Std.Dev	Mean	Median	Std.Dev
Return	0.40	0.27	1.91									
		CRP			*rel.RP*			*MPR*			*ERP*	
β_{RP}	0.37	0.34	1.15	0.02	0.01	0.08	0.03	0.01	0.37	0.06	0.04	0.14
β_{MKT}	0.03	0.01	0.12	0.02	0.01	0.11	0.04	0.03	0.11	0.03	0.01	0.12
β_{SMB}	-0.07	-0.06	0.11	-0.06	-0.06	0.11	-0.07	-0.06	0.11	-0.06	-0.06	0.11
β_{HML}	0.01	0.00	0.14	0.01	0.00	0.14	0.01	0.00	0.14	0.02	0.01	0.14
β_{DEF}	0.53	0.40	1.77	0.79	0.72	1.77	1.40	0.99	2.20	0.35	0.42	1.77
β_{TERM}	0.07	0.09	0.42	0.07	0.10	0.43	0.06	0.10	0.45	0.07	0.09	0.44
β_{LIQ}	0.98	0.92	0.88	0.95	0.88	0.87	0.93	0.86	0.87	0.91	0.87	0.89

Table 3. Portfolios of Bonds Sorted on Credit Risk premium

At each month, we sort bonds into five portfolios according to the firm's credit risk premium ($\widehat{RP}_t$, $\widehat{rel.RP}_t$, $\widehat{MRP}_t$, or $\widehat{ERP}_t$) reflecting time t-1 conditional expectation. The holding period for the bonds is one month and we rebalance the portfolios monthly. The sample period is from November 2002 to August 2016. P.L contains bonds of firms with the lowest credit risk premium and P.H contains bonds of firms with the highest credit risk premium. The portfolios are equally-weighted, and we report the average returns of the quintiles as well as portfolio alphas. Alphas are calculated from Bai, Bali and Wen (2019) bond market four-factor model and FFBai9 bond and stock market nine-factor model. The Bai, Bali and Wen (2019) bond market four factors are: Bond Market, Downside Risk, Credit Risk, and Liquidity Risk. The FFBai9 model combines the four bond factors and Fama and French (2015) five stock market factors: *MKT*, *SMB*, *HML*, *RMW*, and *CMA*. All the returns are reported in percentage per month. H-L stands for the average return and alphas for the P.H - P.L portfolios. Newey-West adjusted t-statistics are shown in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	P.L	P.2	P.3	P.4	P.H	H-L
Panel A: Portfolios sorted by $\widehat{RP}_t$						
Average ret	0.410	0.471	0.507	0.609	0.781	0.371***
	(4.34)	(5.50)	(5.76)	(5.15)	(5.41)	(3.89)
Bai4 Alpha	0.091	0.147	0.172	0.163	0.258	0.168**
	(1.52)	(3.31)	(3.41)	(3.14)	(3.13)	(2.03)
FFBai9 Alpha	0.085	0.153	0.161	0.144	0.246	0.161*
	(1.39)	(3.85)	(3.44)	(3.22)	(2.70)	(1.78)
Panel B: Portfolios sorted by $\widehat{rel.RP}_t$						
Average ret	0.403	0.496	0.534	0.679	0.704	0.301***
	(4.47)	(5.35)	(5.54)	(5.83)	(5.97)	(4.74)
Bai4 Alpha	0.052	0.165	0.182	0.246	0.255	0.204***
	(1.15)	(3.32)	(3.80)	(4.87)	(3.71)	(3.22)
FFBai9 Alpha	0.038	0.159	0.173	0.235	0.242	0.204***
	(0.85)	(3.35)	(3.82)	(5.01)	(3.27)	(3.04)
Panel C: Portfolios sorted by $\widehat{MRP}_t$						
Average ret	0.386	0.454	0.575	0.714	0.693	0.307***
	(4.24)	(5.53)	(6.29)	(6.23)	(5.50)	(4.23)
Bai4 Alpha	0.034	0.165	0.191	0.277	0.228	0.194**
	(0.71)	(3.10)	(3.86)	(4.77)	(2.98)	(2.46)
FFBai9 Alpha	0.027	0.170	0.193	0.242	0.229	0.202**
	(0.57)	(3.32)	(3.75)	(4.70)	(2.69)	(2.27)
Panel D: Portfolios sorted by $\widehat{ERP}_t$						
Average ret	0.391	0.422	0.556	0.762	0.714	0.323***
	(4.30)	(4.90)	(5.92)	(6.41)	(5.49)	(3.91)
Bai4 Alpha	0.040	0.112	0.193	0.322	0.219	0.179**
	(0.87)	(2.39)	(3.60)	(5.36)	(2.84)	(2.11)
FFBai9 Alpha	0.033	0.118	0.198	0.277	0.210	0.177*
	(0.72)	(2.87)	(3.56)	(5.75)	(2.51)	(1.95)

Table 4. Asset Pricing Tests of Individual Bonds

This table reports results of cross-sectional regression tests of individual bonds using the Fama and MacBeth methodology in which betas are estimated over rolling past five-year period for each bond. The sample period is from November 2002 to August 2016. The dependent variable is a bond's monthly return in excess of the one-month T-bill rate. β_{RP} is the betas of the marketwide credit risk premium factor: *CRP*, *rel.RP*, *MPR*, or *ERP*. β_{MKT} , β_{SMB} , β_{HML} , β_{DEF} , and β_{TERM} are betas of equity market, size, book-to-market, default, and term factors. β_{LIQ} is the beta of liquidity innovation based on Amihud (2002) measure. Each right-had-side variable of the regression is normalized by its cross-sectional standard deviation every month, and hence its coefficient is readily interpretable as the premium (or return) per unit of standard deviation of each variable. We also include bond characteristics such as *Size*, M*aturity*, *Age*, *Coupon*, and *Rating* for robustness check. Newey-West adjusted t-statistics are reported in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	Size	Maturity	Age	Coupon	Ratings	R^2
CRP	0.318***	0.057***												0.023
	(2.89)	(3.15)												
	0.248***	0.088***	0.066*	0.011	0.037**	0.027	0.063**							0.120
	(2.70)	(3.52)	(1.73)	(0.45)	(1.99)	(0.98)	(2.34)							
	0.221**	0.094***	0.076**	0.019	0.029*	0.026	0.065**	0.062**						0.145
	(2.61)	(3.86)	(2.00)	(0.82)	(1.85)	(0.94)	(2.40)	(2.04)						
	0.219	0.051***	0.023	0.005	0.003	0.025	0.040*	0.026	-0.021*	0.011*	0.001	0.006	0.022**	0.267
	(1.27)	(2.88)	(1.01)	(0.34)	(0.32)	(1.23)	(1.95)	(1.59)	(-1.70)	(1.69)	(0.44)	(0.62)	(2.16)	
rel.RP	0.311***	0.060**												0.036
	(3.03)	(2.25)												
	0.249***	0.086***	0.073**	0.010	0.032*	0.016	0.052**							0.121
	(2.72)	(2.70)	(2.00)	(0.45)	(1.72)	(0.68)	(2.48)							
	0.223***	0.092***	0.083**	0.016	0.021	0.017	0.060***	0.063**						0.145
	(2.62)	(3.25)	(2.28)	(0.74)	(1.29)	(0.73)	(2.79)	(2.11)						
	0.218	0.032**	0.032	0.003	-0.002	0.020	0.037**	0.025	-0.022*	0.011*	0.001	0.005	0.022**	0.267
	(1.26)	(2.08)	(1.55)	(0.21)	(-0.14)	(1.11)	(2.23)	(1.47)	(-1.75)	(1.70)	(0.36)	(0.52)	(2.11)	
MPR	0.315***	0.067**												0.041
	(3.07)	(2.39)												
	0.260***	0.106***	0.068*	0.008	0.034*	0.021	0.048**							0.124
	(2.89)	(3.16)	(1.90)	(0.37)	(1.91)	(0.75)	(2.21)							
	0.230***	0.102***	0.074**	0.011	0.026	0.020	0.055**	0.061**						0.149
	(2.79)	(3.33)	(2.11)	(0.48)	(1.61)	(0.80)	(2.52)	(2.08)						
	0.233	0.033**	0.026	0.003	0.004	0.023	0.032*	0.025	-0.022*	0.011*	0.001	0.005	0.022**	0.266
	(1.34)	(2.09)	(1.28)	(0.18)	(0.36)	(1.25)	(1.93)	(1.47)	(-1.79)	(1.73)	(0.35)	(0.59)	(2.08)	
ERP	0.336***	0.045**												0.024
	(3.14)	(2.16)												
	0.261***	0.076***	0.073**	0.007	0.037*	0.014	0.048**							0.126
	(2.96)	(2.82)	(2.00)	(0.30)	(1.88)	(0.50)	(2.03)							
	0.234***	0.084***	0.081**	0.015	0.027	0.022	0.060**	0.062**						0.149
	(2.89)	(3.18)	(2.25)	(0.64)	(1.60)	(0.81)	(2.49)	(2.09)						
	0.198	0.043***	0.030	0.003	0.003	0.029	0.037*	0.026	-0.019	0.011*	0.001	0.005	0.022**	0.268
	(1.15)	(2.61)	(1.42)	(0.22)	(0.23)	(1.33)	(1.77)	(1.53)	(-1.58)	(1.70)	(0.28)	(0.57)	(2.18)	

Table 5. Portfolio sorts and asset pricing tests controlling for Bond Characteristics

At the beginning of each month, we first sort bonds into three portfolios based on *Size* /*Maturity*, or two portfolios based on *Rating*. Then, we sort the bonds into three portfolios by credit risk premium within the portfolios based on bond characteristics. The sample period is from November 2002 to August 2016. The portfolios are equally-weighted, and we report the average returns of the quintiles as well as portfolio alphas in Panel A. Alphas are calculated from Bai, Bali and Wen (2019) bond market four-factor model and FFBai9 bond and stock market nine-factor model. Spreads between highest and lowest credit risk premium groups are reported. Panel B reports results of cross-sectional regression tests of individual bonds using the Fama-MacBeth methodology, within different *Size*, *Maturity* or *Rating* portfolios. The betas are estimated over rolling past five-year period for each bond. The dependent variable is a bond's monthly return in excess of the one-month T-bill rate. β_{RP} is the betas of the marketwide credit risk premium factor: *CRP*, *rel.RP*, *MPR*, or *ERP*. β_{MKT} , β_{SMB} , β_{HML} , β_{DEF} , and β_{TERM} are betas of *MKT*, *SMB*, *HML*, *DEF*, and *TERM* factors. β_{LIQ} is the beta of liquidity innovation based on Amihud (2002) measure. Each right-hand-side variable of the regression is normalized by its cross-sectional standard deviation every month. Newey-West adjusted t-statistics are reported in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Portfolio sorts controlling bond characteristics.

	Size.S	Size.M	Size.B	TTM.S	TTM.M	TTM.L	IG bonds	HY bonds
H-L portfolios sorted by $\widehat{RP}_t$:								
Ret	0.279***	0.270***	0.181**	0.190***	0.274***	0.308***	0.166***	0.556***
	(4.27)	(4.27)	(2.41)	(4.13)	(4.11)	(3.02)	(2.93)	(3.45)
Bai4	0.162**	0.101*	0.055	0.080**	0.105*	0.077	0.050	0.367**
	(2.38)	(1.66)	(0.73)	(2.46)	(1.72)	(0.74)	(0.98)	(2.04)
FFBai9	0.157**	0.100	0.033	0.074**	0.094	0.050	0.040	0.327*
	(2.26)	(1.58)	(0.41)	(2.05)	(1.47)	(0.46)	(0.77)	(1.72)
H-L portfolios sorted by $\widehat{rel.RP}_t$:								
Ret	0.276***	0.264***	0.142**	0.144***	0.253***	0.331***	0.138***	0.532***
	(5.16)	(4.68)	(2.03)	(3.77)	(4.63)	(3.60)	(3.20)	(3.44)
Bai4	0.223***	0.158**	0.057	0.076**	0.160**	0.134	0.072	0.370**
	(3.73)	(2.60)	(0.65)	(2.27)	(2.60)	(1.43)	(1.64)	(2.16)
FFBai9	0.236***	0.165***	0.019	0.073**	0.155***	0.125	0.075*	0.362**
	(3.59)	(2.74)	(0.24)	(2.06)	(2.79)	(1.30)	(1.84)	(1.98)
H-L portfolios sorted by $\widehat{MRP}_t$:								
Return	0.362***	0.303***	0.272***	0.178***	0.347***	0.370***	0.193***	0.465***
	(5.86)	(5.22)	(3.78)	(4.27)	(6.11)	(4.09)	(4.44)	(2.93)
Bai4	0.276***	0.187***	0.206**	0.089***	0.234***	0.163**	0.107**	0.310*
	(4.54)	(3.23)	(2.40)	(2.72)	(3.89)	(2.00)	(2.56)	(1.79)
FFBai9	0.287***	0.186***	0.148*	0.091**	0.209***	0.145*	0.098**	0.330*
	(4.48)	(3.17)	(1.74)	(2.59)	(3.65)	(1.68)	(2.45)	(1.85)
H-L portfolios sorted by $\widehat{ERP}_t$:								
Return	0.394***	0.342***	0.306***	0.205***	0.393***	0.459***	0.205***	0.495***
	(5.80)	(5.35)	(4.22)	(5.11)	(6.87)	(4.77)	(5.03)	(3.04)
Bai4	0.298***	0.209***	0.241***	0.119***	0.294***	0.261***	0.139***	0.334*
	(4.64)	(3.30)	(2.70)	(3.68)	(4.97)	(2.81)	(3.36)	(1.86)
FFBai9	0.312***	0.215***	0.190**	0.117***	0.266***	0.234**	0.133***	0.344*
	(4.40)	(3.21)	(2.20)	(3.24)	(4.77)	(2.38)	(3.25)	(1.86)

Panel B: Asset pricing test controlling bond characteristics

B1: Based on Size

		Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	R^2
CRP	Small	0.272***	0.096***	0.088**	0.013	0.020	0.033	0.059*	0.060	0.137
		(3.24)	(3.56)	(2.19)	(0.55)	(0.96)	(0.98)	(1.80)	(1.65)	
	Medium	0.246***	0.068***	0.081**	0.034	0.041**	0.036	0.034	0.062*	0.185
		(2.66)	(2.77)	(2.13)	(1.15)	(2.13)	(1.40)	(1.56)	(1.91)	
	Large	0.235**	0.051**	0.064*	0.011	0.031*	0.024	0.026	0.023	0.209
		(2.49)	(2.42)	(1.79)	(0.47)	(1.81)	(1.12)	(1.14)	(0.78)	
rel. RP	Small	0.273***	0.094***	0.097**	0.018	0.016	0.028	0.058**	0.062*	0.135
		(3.20)	(3.00)	(2.52)	(0.76)	(0.75)	(0.96)	(2.18)	(1.79)	
	Medium	0.237**	0.082***	0.082**	0.032	0.033*	0.039	0.043*	0.066**	0.187
		(2.58)	(2.82)	(2.17)	(1.10)	(1.74)	(1.47)	(1.85)	(1.99)	
	Large	0.235**	0.058	0.065*	0.001	0.020	0.028	0.023	0.018	0.219
		(2.37)	(1.63)	(1.95)	(0.06)	(1.18)	(1.18)	(0.89)	(0.58)	
MPR	Small	0.278***	0.102***	0.087**	0.009	0.019	0.041	0.048*	0.062*	0.141
		(3.33)	(2.94)	(2.35)	(0.42)	(0.89)	(1.32)	(1.78)	(1.82)	
	Medium	0.246***	0.083***	0.075**	0.025	0.037**	0.030	0.047**	0.066**	0.185
		(2.73)	(2.92)	(1.99)	(0.87)	(2.08)	(1.15)	(2.13)	(2.00)	
	Large	0.239**	0.065*	0.064*	0.002	0.022	0.027	0.029	0.017	0.218
		(2.53)	(1.79)	(1.87)	(0.10)	(1.29)	(1.07)	(1.22)	(0.55)	
ERP	Small	0.273***	0.089***	0.085**	0.009	0.022	0.037	0.058**	0.061*	0.140
		(3.36)	(3.30)	(2.32)	(0.39)	(1.05)	(1.11)	(2.03)	(1.80)	
	Medium	0.253***	0.048*	0.072**	0.025	0.040**	0.036	0.054**	0.063**	0.185
		(2.90)	(1.71)	(2.04)	(0.84)	(2.26)	(1.21)	(2.34)	(2.00)	
	Large	0.238***	0.069*	0.072*	0.011	0.037**	0.034	0.026	0.027	0.221
		(2.67)	(1.84)	(1.97)	(0.47)	(2.20)	(1.31)	(1.08)	(0.96)	

B2: Based on Maturity

		Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	R^2
CRP	Short	0.106**	0.057**	0.100***	0.007	0.012	0.013	0.053	0.038*	0.353
		(2.48)	(2.02)	(2.76)	(0.25)	(0.55)	(0.38)	(1.56)	(1.84)	
	Medium	0.243***	0.068***	0.080**	0.024	0.010	0.025	0.041**	0.032**	0.129
		(2.90)	(3.78)	(2.57)	(1.36)	(0.88)	(1.16)	(2.05)	(2.09)	
	Long	0.345**	0.103***	0.074	0.027	-0.002	0.081**	0.024	0.061**	0.119
		(2.15)	(3.00)	(1.61)	(0.98)	(-0.09)	(2.25)	(1.10)	(2.56)	
rel.RP	Short	0.109***	0.040	0.109***	0.013	0.016	0.026	0.072**	0.038*	0.348
		(3.20)	(1.39)	(2.66)	(0.64)	(0.74)	(0.88)	(2.33)	(1.72)	
	Medium	0.252***	0.063**	0.083**	0.023	0.005	0.016	0.031*	0.029*	0.128
		(2.91)	(2.48)	(2.59)	(1.46)	(0.41)	(0.80)	(1.96)	(1.83)	
	Long	0.334**	0.103**	0.068	0.020	0.005	0.071**	0.035	0.063***	0.119
		(2.03)	(2.40)	(1.52)	(0.75)	(0.22)	(2.01)	(1.43)	(2.66)	
MPR	Short	0.112***	0.046*	0.102***	-0.003	0.015	0.018	0.075**	0.048**	0.350
		(3.21)	(1.66)	(2.98)	(-0.13)	(0.71)	(0.59)	(2.55)	(2.11)	
	Medium	0.251***	0.088***	0.079**	0.021	0.006	0.032	0.029	0.028*	0.132
		(2.94)	(3.12)	(2.57)	(1.23)	(0.48)	(1.38)	(1.61)	(1.76)	
	Long	0.355**	0.114**	0.069	0.018	0.003	0.075**	0.026	0.062**	0.119
		(2.22)	(2.49)	(1.63)	(0.72)	(0.15)	(2.28)	(1.12)	(2.59)	
ERP	Short	0.117***	0.044	0.089***	-0.013	0.024	-0.010	0.078***	0.039*	0.343
		(3.27)	(1.36)	(3.10)	(-0.44)	(1.23)	(-0.27)	(2.66)	(1.78)	
	Medium	0.261***	0.056***	0.081***	0.023	0.011	0.019	0.038*	0.026*	0.130
		(3.17)	(2.79)	(2.68)	(1.36)	(0.87)	(0.85)	(1.86)	(1.69)	
	Long	0.359**	0.090**	0.077*	0.019	0.006	0.071**	0.023	0.062**	0.123
		(2.24)	(2.58)	(1.80)	(0.75)	(0.33)	(2.02)	(1.05)	(2.59)	

B3: Based on Rating

		Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	R^2
CRP	IG	0.217**	0.057***	0.025	-0.008	0.015	0.007	0.056**	0.043	0.155
		(2.41)	(2.64)	(0.75)	(-0.41)	(1.04)	(0.28)	(2.10)	(1.46)	
	HY	0.381***	0.179***	0.081**	0.030	0.036	0.074*	0.087*	0.049	0.188
		(2.85)	(3.59)	(2.02)	(0.98)	(1.02)	(1.90)	(1.74)	(1.32)	
rel.RP	IG	0.216**	0.051*	0.034	-0.010	0.008	-0.006	0.050**	0.045	0.157
		(2.41)	(1.97)	(1.02)	(-0.51)	(0.54)	(-0.27)	(2.51)	(1.45)	
	HY	0.381***	0.122***	0.091**	0.031	0.052	0.054	0.095**	0.047	0.184
		(2.84)	(2.84)	(2.41)	(1.08)	(1.57)	(1.57)	(2.10)	(1.33)	
MRP	IG	0.216**	0.059**	0.031	-0.008	0.010	0.002	0.046**	0.044	0.158
		(2.44)	(2.23)	(0.95)	(-0.43)	(0.67)	(0.07)	(2.37)	(1.48)	
	HY	0.387***	0.134***	0.083**	0.032	0.059*	0.055	0.108**	0.043	0.183
		(2.92)	(3.02)	(2.19)	(1.05)	(1.69)	(1.60)	(2.13)	(1.14)	
ERP	IG	0.229***	0.050**	0.033	-0.008	0.016	-0.006	0.052**	0.046	0.160
		(2.67)	(2.07)	(1.02)	(-0.39)	(1.15)	(-0.27)	(2.41)	(1.57)	
	HY	0.399***	0.115**	0.105***	0.040	0.043	0.050	0.082*	0.044	0.187
		(2.98)	(2.36)	(2.77)	(1.40)	(1.18)	(1.34)	(1.94)	(1.21)	

Table 6. Longer Holding Horizon

At the beginning of each month, we sort bonds into quintiles according to the firm's credit risk premia ($\widehat{RP}_t$, $\widehat{rel.RP}_t$, $\widehat{MRP}_t$, or $\widehat{ERP}_t$) , but hold these portfolios over one to four months. The sample period is from November 2002 to August 2016. The portfolios are equally-weighted, and we report the average returns of the quintiles as well as portfolio alphas. Alphas are calculated from Bai, Bali and Wen (2019) bond market four-factor model and FFBai9 bond and stock market nine-factor model. Newey-West adjusted t-statistics are reported in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Holding Horizon				Holding Horizon			
	1	2	3	4	1	2	3	4
	$\widehat{RP}_t$				$\widehat{rel.RP}_t$			
Average Ret	0.371***	0.111*	0.062	0.053	0.301***	0.111*	0.062	0.053
	(3.89)	(1.67)	(0.85)	(0.69)	(4.74)	(1.67)	(0.85)	(0.69)
Bai4 Alpha	0.168**	0.009	-0.056	-0.028	0.204***	0.009	-0.056	-0.028
	(2.03)	(0.13)	(-0.79)	(-0.32)	(3.22)	(0.13)	(-0.79)	(-0.32)
FFBai9 Alpha	0.161*	0.007	-0.068	-0.046	0.204***	0.007	-0.068	-0.046
	(1.78)	(0.08)	(-0.92)	(-0.49)	(3.04)	(0.08)	(-0.92)	(-0.49)
	$\widehat{MPR}_t$				$\widehat{ERP}_t$			
Average Ret	0.307***	0.124*	0.077	0.074	0.323***	0.182**	0.110	0.097
	(4.23)	(1.70)	(1.03)	(1.02)	(3.91)	(2.26)	(1.33)	(1.24)
Bai4 Alpha	0.194**	0.038	-0.026	-0.020	0.179**	0.102	-0.017	-0.016
	(2.46)	(0.47)	(-0.32)	(-0.23)	(2.11)	(1.16)	(-0.19)	(-0.18)
FFBai9 Alpha	0.202**	0.047	-0.032	-0.014	0.177*	0.095	-0.018	-0.019
	(2.27)	(0.55)	(-0.40)	(-0.16)	(1.95)	(1.07)	(-0.22)	(-0.20)

Table 7. Portfolio analysis and asset pricing tests for Pre-Crisis or Post-Crisis period

We divide the samples into two groups: Pre-Crisis period (November 2002 to June 2007) and Post-Crisis Period (June 2009 to August 2016). Similar to Table 3, H-L portfolios spreads and alphas in the sub-periods are shown in Panel A. Alphas are calculated from Bai, Bali and Wen (2019) bond market four-factor model and FFBai9 bond and stock market nine-factor model. Panel B reports results of cross-sectional regression tests of individual bonds using the Fama-MacBeth methodology in the sub-periods. The betas are estimated over rolling past five-year period for each bond. The dependent variable is a bond's monthly return in excess of the one-month T-bill rate. β_{RP} is the betas of the marketwide credit risk premium factor: *CRP*, *rel.RP*, *MPR*, or *ERP*. β_{MKT} , β_{SMB} , β_{HML} , β_{DEF} , and β_{TERM} are betas of equity market, size, book-to-market, default, and term factors. β_{LIQ} is the beta of liquidity innovation based on Amihud (2002) measure. All the betas are normalized by its cross-sectional standard deviation every month. We also control bond characteristics, such as size, maturity, age, coupon, and rating, in the cross-sectional regression. Newey-West adjusted t-statistics are reported in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: H-L portfolios spreads in Pre/Post Crisis periods.

	Sorted by $\widehat{RP}_{\mathrm{t}}$		Sorted by $\widehat{relRP}_{\mathrm{t}}$		Sorted by $\widehat{MPR}_{\mathrm{t}}$		Sorted by $\widehat{ERP}_{\mathrm{t}}$	
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis
Average ret	0.514***	0.230***	0.563***	0.238***	0.514***	0.230***	0.563***	0.238***
	(4.77)	(3.37)	(4.64)	(2.98)	(4.77)	(3.37)	(4.64)	(2.98)
Bai4 Alpha	0.268**	0.114*	0.289**	0.142*	0.268**	0.114*	0.289**	0.142*
	(2.08)	(1.73)	(2.30)	(1.74)	(2.08)	(1.73)	(2.30)	(1.74)
FFBai9 Alpha	0.371***	0.118*	0.369***	0.125*	0.371***	0.118*	0.369***	0.125*
	(3.05)	(1.76)	(2.96)	(1.72)	(3.05)	(1.76)	(2.96)	(1.72)

Panel B: Asset pricing tests in Pre/Post Crisis periods.

		Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	Size	TTM	Age	Coupon	Ratings	R^2
CRP	Pre	-0.273	0.072***	0.018	0.033*	0.035***	0.073**	-0.001	0.034	0.008	0.001	-0.002	-0.001	0.030***	0.288
		(-1.24)	(3.69)	(0.83)	(1.71)	(2.97)	(2.39)	(-0.05)	(1.15)	(0.64)	(0.10)	(-0.57)	(-0.14)	(4.64)	
	Post	0.299	0.029**	0.055**	-0.014	0.004	-0.013	0.025**	0.027**	-0.023	0.025***	-0.000	-0.003	0.040***	0.282
		(1.13)	(2.24)	(2.14)	(-0.96)	(0.46)	(-1.00)	(2.05)	(2.23)	(-1.35)	(3.35)	(-0.05)	(-0.29)	(3.50)	
rel.RP	Pre	-0.303	0.057**	0.025	0.032	0.037***	0.053*	0.004	0.036	0.008	0.000	-0.002	0.003	0.030***	0.289
		(-1.41)	(2.21)	(1.13)	(1.46)	(3.32)	(1.92)	(0.22)	(1.31)	(0.57)	(0.05)	(-0.38)	(0.33)	(4.24)	
	Post	0.317	0.037**	0.058**	-0.012	0.006	-0.012	0.031**	0.026**	-0.023	0.025***	-0.000	-0.005	0.040***	0.282
		(1.20)	(2.64)	(2.32)	(-0.83)	(0.59)	(-0.86)	(2.54)	(2.00)	(-1.35)	(3.39)	(-0.14)	(-0.47)	(3.49)	
MPR	Pre	-0.280	0.060**	0.019	0.027	0.040***	0.043	0.010	0.039	0.011	0.000	-0.003	0.003	0.027***	0.286
		(-1.25)	(2.21)	(0.86)	(1.30)	(3.49)	(1.65)	(0.59)	(1.41)	(0.80)	(0.03)	(-0.72)	(0.37)	(3.89)	
	Post	0.320	0.038**	0.054**	-0.015	0.007	-0.005	0.026**	0.024**	-0.024	0.025***	-0.000	-0.004	0.040***	0.282
		(1.20)	(2.64)	(2.16)	(-1.04)	(0.75)	(-0.39)	(2.12)	(1.99)	(-1.40)	(3.37)	(-0.14)	(-0.40)	(3.54)	
ERP	Pre	-0.290	0.064**	0.024	0.034	0.036***	0.071**	0.007	0.034	0.009	0.001	-0.001	0.001	0.029***	0.290
		(-1.32)	(2.44)	(1.24)	(1.65)	(2.99)	(2.10)	(0.37)	(1.21)	(0.66)	(0.09)	(-0.33)	(0.08)	(4.15)	
	Post	0.283	0.035**	0.058**	-0.015	0.007	-0.005	0.024*	0.025**	-0.020	0.024***	-0.000	-0.005	0.040***	0.284
		(1.08)	(2.28)	(2.28)	(-0.99)	(0.70)	(-0.32)	(1.97)	(2.01)	(-1.24)	(3.27)	(-0.08)	(-0.43)	(3.53)	

Table 8. Portfolio analysis and asset pricing tests for Low/High sentiment period

This table reports results of H-L portfolios analysis and cross-sectional regression tests of individual bonds using the Fama and MacBeth methodology in the sub-samples. The sample period is from November 2002 to August 2016. We divide the samples into two groups (Low and High sentiment periods) according the VIX by the median VIX of full sample. β_{RP} is the betas of the marketwide credit risk premium factor: *CRP*, *rel.RP*, *MPR*, or *ERP*. β_{MKT} , β_{SMB} , β_{HML} , β_{DEF} , and β_{TERM} are betas of *MKT*, *SMB*, *HML*, *DEF*, and *TERM* factors. β_{LIQ} is the beta of liquidity innovation based on Amihud (2002) measure. We also control bond characteristics, such as *Size*, *Maturity*, *Age*, *Coupon*, and *Rating*, in the cross-sectional regression. Newey-West adjusted t-statistics are reported in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: H-L portfolio spreads in Low/High Sentiment periods.

	Sorted by $\widehat{RP}_t$		Sorted by $\widehat{relRP}_t$		Sorted by $\widehat{MPR}_t$		Sorted by $\widehat{ERP}_t$	
	Low	High	Low	High	Low	High	Low	High
Average ret	0.215**	0.523***	0.213***	0.386***	0.285***	0.329***	0.285***	0.360***
	(2.58)	(3.55)	(3.06)	(3.78)	(3.53)	(2.89)	(3.36)	(2.73)
Bai4 Alpha	0.124	0.210	0.137*	0.268**	0.173**	0.183	0.175**	0.146
	(1.34)	(1.35)	(1.80)	(2.37)	(2.09)	(1.44)	(2.10)	(0.95)
FFBai9 Alpha	0.128	0.251	0.116	0.309**	0.153	0.259*	0.141	0.198
	(1.16)	(1.37)	(1.34)	(2.58)	(1.61)	(1.78)	(1.45)	(1.16)

Panel B: Asset pricing tests in Low/High Sentiment periods

		Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	Size	Maturity	Age	Coupon	Ratings	R^2
CRP	Low	0.155	0.034***	0.012	0.005	0.020**	0.037**	0.011	0.019	-0.017	0.005	-0.000	0.003	0.023***	0.302
		(0.82)	(2.92)	(0.83)	(0.42)	(2.45)	(2.34)	(1.06)	(1.32)	(-1.51)	(0.79)	(-0.08)	(0.56)	(3.42)	
	High	0.289	0.067***	0.039	0.004	-0.012	0.013	0.078**	0.032	-0.018	0.020**	0.002	0.009	0.028*	0.228
		(0.81)	(3.16)	(1.36)	(0.20)	(-0.92)	(0.55)	(2.62)	(1.50)	(-0.73)	(2.53)	(0.47)	(0.68)	(1.94)	
rel.RP	Low	0.132	0.030**	0.014	0.003	0.021***	0.024	0.020*	0.023	-0.016	0.006	0.000	0.006	0.023***	0.302
		(0.70)	(2.08)	(0.92)	(0.21)	(2.68)	(1.55)	(1.78)	(1.45)	(-1.39)	(0.79)	(0.02)	(0.94)	(3.25)	
	High	0.313	0.044**	0.048*	0.007	-0.021	0.007	0.068***	0.031	-0.020	0.020**	0.002	0.008	0.028*	0.228
		(0.88)	(2.39)	(1.76)	(0.31)	(-1.52)	(0.31)	(3.05)	(1.40)	(-0.83)	(2.60)	(0.42)	(0.56)	(1.91)	
MPR	Low	0.151	0.026*	0.011	0.001	0.022***	0.025*	0.011	0.022	-0.015	0.006	-0.001	0.006	0.022***	0.300
		(0.78)	(1.80)	(0.73)	(0.08)	(2.85)	(1.82)	(1.12)	(1.48)	(-1.31)	(0.83)	(-0.31)	(1.03)	(3.34)	
	High	0.323	0.051**	0.044	0.004	-0.018	0.021	0.075***	0.034	-0.022	0.020**	0.002	0.008	0.026*	0.228
		(0.91)	(2.56)	(1.66)	(0.18)	(-1.36)	(0.86)	(3.08)	(1.64)	(-0.91)	(2.62)	(0.48)	(0.57)	(1.74)	
ERP	Low	0.147	0.020	0.012	0.003	0.023***	0.031*	0.016	0.017	-0.016	0.005	0.000	0.004	0.023***	0.303
		(0.77)	(1.47)	(0.92)	(0.30)	(2.79)	(1.75)	(1.49)	(1.19)	(-1.42)	(0.78)	(0.01)	(0.72)	(3.53)	
	High	0.253	0.062***	0.050*	-0.002	-0.020	0.023	0.066**	0.036	-0.012	0.019**	0.002	0.008	0.028*	0.230
		(0.73)	(3.24)	(1.86)	(-0.07)	(-1.48)	(0.80)	(2.35)	(1.64)	(-0.51)	(2.47)	(0.38)	(0.58)	(1.94)	

Table 9. Asset pricing tests at firm level

This table reports results of cross-sectional regression tests at firm level using the Fama and MacBeth methodology. The full sample period is from November 2002 to August 2016. The betas are estimated over rolling past five-year period for each firm. We calculate firm-level return as the equal-weighted average of all bond returns for a give firm. The dependent variable is a firm's monthly return in excess of the one-month T-bill rate. β_{RP} is the betas of the marketwide credit risk premium factor: *CRP*, *rel.RP*, *MPR*, or *ERP*. β_{MKT} , β_{SMB} , β_{HML} , β_{DEF} , and β_{TERM} are betas of *MKT*, *SMB*, *HML*, *DEF*, and *TERM* factors. β_{LIQ} is the beta of liquidity innovation based on Amihud (2002) measure. All the betas are normalized by its cross-sectional standard deviation every month, and hence its coefficient is readily interpretable as the premium per unit of standard deviation of each variable. Newey-West adjusted t-statistics are reported in the parenthesis. The signs *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Intercept	β_{RP}	β_{MKT}	β_{SMB}	β_{HML}	β_{DEF}	β_{TERM}	β_{LIQ}	R^2
CRP	0.336***	0.058***							0.027
	(3.08)	(3.05)							
	0.255***	0.086***	0.072**	0.029	0.026	0.034*	0.042**		0.121
	(2.86)	(4.70)	(2.07)	(1.53)	(1.63)	(1.85)	(2.61)		
	0.239***	0.085***	0.076**	0.035*	0.017	0.032*	0.038***	0.062**	0.143
	(2.93)	(4.44)	(2.27)	(1.85)	(1.19)	(1.83)	(2.64)	(2.46)	
rel.RP	0.322***	0.060**							0.038
	(3.18)	(2.20)							
	0.256***	0.081***	0.074**	0.024	0.022	0.010	0.051***		0.122
	(2.83)	(3.10)	(2.21)	(1.29)	(1.48)	(0.57)	(3.31)		
	0.240***	0.082***	0.080***	0.031	0.015	0.015	0.045***	0.063**	0.143
	(2.87)	(3.48)	(2.63)	(1.64)	(1.10)	(0.84)	(3.10)	(2.60)	
MPR	0.327***	0.069**							0.043
	(3.23)	(2.50)							
	0.268***	0.094***	0.069**	0.021	0.023	0.009	0.047***		0.126
	(3.03)	(3.41)	(2.17)	(1.19)	(1.54)	(0.49)	(2.90)		
	0.250***	0.093***	0.070**	0.025	0.019	0.009	0.042***	0.061**	0.148
	(3.08)	(3.53)	(2.42)	(1.37)	(1.37)	(0.55)	(2.94)	(2.43)	
ERP	0.357***	0.047**							0.025
	(3.34)	(2.52)							
	0.266***	0.075***	0.075**	0.023	0.024	0.012	0.038**		0.125
	(2.98)	(3.60)	(2.23)	(1.20)	(1.52)	(0.57)	(2.54)		
	0.250***	0.066***	0.083***	0.025	0.016	0.011	0.037***	0.062**	0.145
	(3.08)	(3.18)	(2.68)	(1.27)	(1.13)	(0.54)	(2.67)	(2.48)	