Idiosyncratic Downside Risk
and the Credit spread Puzzle

by

Gordon Gemmill and Aneel Keswani*

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ABSTRACT

The puzzle is that spreads on corporate bonds are about twice as large as can be explained by defaults, taxes and illiquidity. The higher a bond's rating and the shorter its maturity, the greater is the puzzle. We use a large dataset of bonds to identify the relevant risk factors. Systematic factors fail to generate large spreads, regardless of whether they are conventional (market covariance, size and book-to-market) or have a downside character (co-skewness and downside covariance). Idiosyncratic factors are much more successful in generating plausible spreads, not only idiosyncratic equity volatility but especially idiosyncratic bond value-at-risk. Our explanation of this result is twofold. First, idiosyncratic risk matters because a bond is priced from the risk-neutral distribution of firm value. Second, bond value-at-risk is a good proxy for the fat left-hand tail of that distribution, which reflects a large risk-premium for extreme returns on the downside.

Keywords: bond, idiosyncratic risk, credit spread, value-at-risk

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* Contact details: Gordon Gemmill-Warwick Business School, University of Warwick, Coventry CV4 7AL, United Kingdom, phone (44) (0) 24 7652 4542, email gordon.gemmill@wbs.ac.uk. Aneel Keswani-Cass Business School, 106 Bunhill Row, London EC1Y 8TZ, United Kingdom, phone (+44) 207 040 8763, fax (+44) 207 040 8881, e-mail a.keswani@city.ac.uk. We thank Keith Cuthbertson, Miguel Ferreira, Ian Marsh, Richard Payne, Pedro Santa Clara, David Stolin, Lorenzo Trapani and seminar participants at Cass Business School, ISCTE Lisbon, University of Bristol and Warwick Business School. We also thank JingFeng Ahn and Myria Kyriakou for help with data. All errors and omissions are ours.

1. Introduction

Many researchers have found that observed spreads on corporate bonds are far larger than would be expected, given their seemingly low risks. Spreads are larger than can be justified by expected losses from default (e.g. Elton, Gruber, Agrawal and Mann, 2001) and larger than generated by most option-based models which depend on the distribution of firm value (e.g. Eom, Helwege and Huang, 2004; Huang and Huang, 2003). This has become known as "the credit spread puzzle". It is particularly severe for bonds which have high ratings and only a small time to maturity. Given this spread-premium, we might expect to see investors flocking to hold corporate bonds and the apparent anomaly being corrected. The persistence of the gap, between the observed yield and (what is believed to be) a "fair" yield, suggests either that investors are badly informed or that the true risks of holding corporate bonds have not been fully understood.

Possible explanations for the large spreads include taxes, a lack of liquidity, or an exposure to jump risk. Considering these in turn, taxes may account for some of the spread on US bonds (Elton et al, 2001), but European corporate bonds also show large spreads despite the fact that no comparable tax is levied (de Jong and Driessen, 2006). Liquidity has been widely analysed, but does not seem able to explain more than about 25 basis points of the spread, whereas the puzzle is several times that size (Ericsson and Renault, 2006; Perraudin and Taylor, 2004; Longstaff, Mithal and Neis, 2005; Chen, Lesmond and Wei, 2007). Jump risk, as measured empirically, is also too small to account for more than 30 basis points of the investment-grade spread (Driessen, 2005) and much of that risk is potentially diversifiable (Collin-Dufresne, Martin and Helwege, 2003). Because taxes, liquidity and expected losses can explain less than half of observed spreads, it is likely that a risk premium plays an important role.

The aim of our paper is to assess whether various measures of risk, derived from past bond returns, are able to generate risk premia of a sufficiently large size to explain credit spreads in the current period. Our study stands in contrast to most prior investigations which have used ex-post bond returns (rather than spreads) in the second stage of their asset pricing tests.[1] Yet it would seem natural to use spreads in the second stage, because they incorporate a forward-looking risk premium.[2] Moreover, the promised returns in spreads do not suffer from as much noise as ex-post bond returns, so we can obtain significant results with a relatively short time series (covering 8 years of data). Our raw sample comprises a set of 1451 US corporate bonds of investment grade at weekly intervals from January 1997 to December 2004, resulting in 313,791 bond-week observations. After removing outliers, there remain 254,343 useable bond-week observations.

In considering the risks on bonds, our first approach is to use the three Fama/French systematic factors. Elton et al (2001) suggest that these systematic risks –market covariance[3], SMB and HML -- may be important, but we find that they explain only 9% (11 basis points) of the average A-rated spread. These conventional factors are assumed to have a symmetric influence on spreads, whereas Amato and Remolona (2003, 2005) argue that credit spreads reflect undiversifiable skewness.[4] We therefore move on to test whether systematic coskewness risk (Harvey and Siddique, 2000) or systematic downside covariance risk (Ang, Chen and Xing, 2006) can explain observed spreads. Again the effects are far too small to explain the large credit spreads which are observed. Consequently, we reach the conclusion that systematic coskewness and other systematic risk factors, even with a downside focus, are not strong candidates for explaining credit spreads.

These negative results drive us to consider, as candidates for explaining the spread, the wider set of

[1] To the best of our knowledge, only Elton et al (2001) have previously made a two-stage (time-series / cross-section) study of bond-pricing which uses returns in the first stage and spreads (after deducting tax and default components) in the second, but they consider only the Fama/French factors. The contemporaneous paper of De Jong and Driessen (2006) uses a similar approach, but their focus is on priced liquidity-risk factors.

[2] The forward-looking equity risk-premium implicit in bonds has been discussed by Cooper and Davydenko (2003) and used by Campello, Guo and Zhang (2007) for testing equity pricing models.

[3] Market risk using the terminology of Fama and French.

[4] They support this argument with examples from the CDO market, which indicate that managers hold much more collateral for bond portfolios than appears necessary for reasons of expected default. They argue that this is consistent with holders of bond portfolios demanding a premium for systematic skewness risk.

variables which would appear in a structural approach to bond pricing. In this approach, it is the risk-neutral distribution of firm value that drives bond prices and it follows that idiosyncratic risk is just as important as systematic risk. For example, it should be the total volatility of the risk-neutral distribution of firm value or its total skewness which is relevant. A direct measure of the risk-neutral distribution cannot be obtained, but we are able to impute its character from bond prices. We estimate the largest downside move in each bond's spread over the last year and split it into a systematic component, related to movements of spreads on all bonds, and an idiosyncratic component, which is the remainder. We call these orthogonal components systematic bond value-at-risk (VaR) and idiosyncratic bond value-at-risk. We then find that idiosyncratic bond value-at-risk has a strong influence on spreads, whereas systematic bond value-at-risk has only a small effect. For example, they explain respectively 42% and 5% of the average weekly spread for A-rated bonds over 1998 to 2004. In our regressions we also control for other factors, of which liquidity (10% of A-rated spreads) and tax (7% of A-rated spreads) are important parts. Expected default loss, which we estimate with a rating-specific dummy variable, accounts for 18% of spreads for A-rated bonds. Together these factors therefore account for about 82% of A-rated spreads. The results for AAA-rated bonds are even more impressive, because for these bonds idiosyncratic bond value-at-risk and systematic bond value-at-risk can explain respectively 52% and 12% of the observed weekly average spread. Higher grade bonds therefore incorporate even larger VaR risk premia into their spreads and this can explain why their spreads are so large despite their probability of default being so low.

It might be the case that bond VaR is just a proxy for equity risk, rather than reflecting the left skewness of the risk-neutral distribution of firm value; in other words, it might not be indicating anything special other than the dispersion of the risk-neutral distribution of firm value, which derives mainly from returns on equity. To check on this possibility, we match most of our bonds with data on their underlying shares. We find that idiosyncratic equity volatility is closely related to the size of bond spreads, as shown by Campbell and Taksler (2003), but that it is dominated by idiosyncratic bond VaR in cross-sectional regressions. For example, when both idiosyncratic equity volatility and idiosyncratic bond VaR are included in the same regression, the former explains only 27 basis points of the A-rated spread, while the latter explains 49 basis points of that spread. If we try using the VaR of equity returns rather than the equity volatility, in order to capture any asymmetry of equity returns, the results are much worse than simply using the equity volatility. The conclusion is that idiosyncratic bond VaR matters, not just because it reflects idiosyncratic equity volatility, but mainly because it reflects a risk premium for extreme bond returns on the downside.

To summarize, the main contribution of this paper is to show that idiosyncratic VaR on bonds can explain a large part of the credit spread puzzle, which is a completely new result. This resolves most of the credit spread puzzle, particularly in relation to the highest rated bonds for which the puzzle is most severe. It suggests that investors demand a large risk premium for extreme downside movements on individual bonds, which is well proxied by idiosyncratic bond VaR. Such a risk premium depends on the underlying pricing kernel and is consistent with studies of the pricing kernel for equities.[5]

The paper is structured as follows. In the next section we set the context for our study by reviewing some of the related literature. In section 3 we describe the data and the asset pricing methodology which we follow. Section 4 gives the main results from the empirical tests and section 5 considers expanded tests which include equity volatility as an explanatory variable. Section 6 reports robustness tests and section 7 discusses why idiosyncratic bond VaR may be so important for spreads. Finally, section 8 draws together the conclusions and implications of this study.

2. Related Literature

The literature gives four reasons why corporate bonds should have higher yields than equivalent government bonds. First and foremost, these bonds might default. Second, corporate bonds are less liquid than government bonds. Third, corporate bondholders have to pay tax on their coupons at the state level whereas government bond holders do not. Fourth, investors are not risk-neutral and therefore demand a

[5] The pricing kernel, as revealed by equity index options, shows very high values to be placed on positive outcomes in extremely bad states of nature. See, for example: Buraschi and Jackwerth, 2001; Rosenberg and Engle, 2002; Bliss and Panigirtzoglou, 2004; Bollen and Whaley, 2004; and Han, 2005.

risk premium for holding credit risky bonds.

Elton, Gruber, Agrawal and Manne (2001) attempt to understand how spreads can be broken down into these components. [6] They begin by showing that the expected loss from default cannot explain more than 35% of observed spreads for BBB bonds and only about 8% of observed spreads for AA bonds. Then they show that US taxes might explain another 23% of the spread for BBB bonds and 48% for AA bonds. [7] That still leaves 42% of the spread for BBB bonds and 44% of the spread for AA bonds to be explained. They suggest that this is due to a premium on **systematic** risk, of which the Fama/French 3-factor model can explain up to 85%.[8] Consequently they conclude that the spread for the highest grade bonds is not based very much on expected default, but much more on taxes, liquidity, and a systematic risk-premium related to the conventional risk factors: market, size and book-to-market.[9]

Several recent studies have followed Elton et al (2001) in examining the extent to which taxes and liquidity may explain the credit spread. The theoretical model of Ericsson and Renault (2005) generates a liquidity spread of about 25 basis points for 10-year bonds. Perraudin and Taylor (2004) estimate with empirical regressions that liquidity can account for about 25 basis points of spread. Cooper and Davydenko (2004) find similar results. Using data on credit default swaps, Longstaff, Mittal and Neis (2005) find a significant impact of liquidity on spreads, but rather little impact of taxes. De Jong and Driessen (2006) attribute 58

[6] Most research has been concerned with explaining spreads rather than explaining ex post returns (consistent with market practice), but exceptions are Fama and French (1993) and Gebhardt, Hvidkjaer and Swanimathan (2005) who focus on bond returns.

[7] Calculations based on Elton et al (2001), Tables 1, 6 and 7.

[8] Elton and Gruber regress the part of return difference between corporate bonds and government bonds unexplained by changes in expected defaults losses or changes in the required compensation for taxes on the Fama and French factors and then relate these sensitivities to spreads. While they can explain a substantial proportion of bond spreads, they do not use individual bonds but rather group together bonds of the same rating and maturity. (Bonds are divided into three rating categories and into nine time to maturity categories making a total of 27 groups of bonds.)

[9] Evidence for a risk premium in high-grade bonds is also borne out in empirical tests of structural models (Eom, Helwege and Huang, 2003), which suggests that the greatest challenge for structural models is being able to explain spreads on high-grade bonds.

basis points of the spread on AA-grade bonds to a liquidity risk premium, but this includes components for both equity related risk and government bond related risk.

Across all of these studies, it seems that default, liquidity and taxes can only explain about half of the observed spreads on investment-grade bonds, so the focus of more recent research has shifted towards the character of the residual risk premium. The evidence suggests that this risk premium is common to both bond and equity markets. Goyal and Santa Clara (2003) show that equity volatility (largely idiosyncratic) is relevant to equity prices. If we think of equity as a call option on firm value, then as volatility rises the value of the equity goes up and the value of the debt goes down. Campbell and Taksler (2003) show that there is a strong positive relationship between idiosyncratic equity volatility and bond spreads, which is consistent with equity and debt as joint claims. Cremers, Driessen and Maenhout (2007) argue that there is a large jump-risk premium in the equity, which is observable in the risk-neutral distribution but not in the objective distribution. From a careful specification of systematic and idiosyncratic jumps and their associated risk premia (based on index options, individual options and an equity risk premium), they generate credit spreads on bonds which are plausible, both in terms of size and in their empirical behaviour over time.

Berd, Engle and Voronov (2005) also emphasise the similarity of risk premia in equity and bond markets, but their application is to the portfolios of bonds in CDOs. Although all of the tranches in a CDO relate to a single bond portfolio, traders assume that the higher the quality of the tranche, the higher is the implied correlation of default between the bonds in the portfolio. Berd, Engle and Voronov argue that this "implied correlation sneer" is a manifestation of the same pricing kernel as is shown by the "volatility sneer" in equity index options: the two sneers arise from the "extra fat" distribution of the underlying risk-neutral distribution of firm value on the downside. Both Cremers et al (2007) and Berd et al (2005) therefore suggest that a large risk premium is a feature of the pricing kernel, which is relevant for all assets including bonds and equities. [10]

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[10] Why the pricing kernel might have this character is not clear. Collin-Dufresne and Goldstein (2006) investigate whether a pricing kernel with habit-formation (from Campbell and Cochrane, 1999) would generate realistic spreads

To summarize, previous research shows that only about half of spreads on AA-rated bonds can be explained by default risk, liquidity and tax. The remaining half seems to be due to a risk premium which reflects the pricing kernel for all assets. Our aim is to examine, in an asset pricing framework, what easily-measurable factors may be good proxies for that risk premium and thus may lead to an explanation of the credit spread puzzle.

3. Data, Measures of Bond Risk and Control Variables

A. Bond Sample Data

Our sample is based on the universe of US corporate bonds contained within the Merrill Lynch Corporate Master index. In order to be included in this index, bonds must be: dollar denominated, issued in the US domestic market, of investment grade, and have a time to maturity of at least one year. In order to establish the sample of bonds studied in our paper, we began by gathering data on constituent bonds in this index each week, using the Bloomberg database over our sample period. We then eliminated bonds that were callable, puttable, had conversion features or had sinking-fund features. We also excluded bonds with any form of step-coupon feature. We then gathered the data required for our analysis at the weekly frequency over the period January 1997 to December 2004, resulting in 414 weeks of data for these bonds. Data were collected on bond indenture information (e.g. issue dates, maturity dates, coupon rates), bond spreads, prices, accrued interest, ratings and the market value of each bond outstanding. We then cleaned the data, checking for missing observations and errors in data entry. The final sample comprises 313,791 bond-week observations for which we have clean data on all bond-relevant variables.

Table 1, Panel A, gives details of the number of bonds in the sample, classified by rating and by year. The number given in the table is for bonds which are "alive" at the beginning of the stated year. As bonds mature and new bonds are issued, the sample changes so there is no survivorship bias. The table shows that

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over time, but find that a counter-cyclical default boundary would also be required.

approximately 15% of the bonds have a rating of AA or AAA, 53% are A-rated and 32% are BBB-rated. Table 1, Panel B, lists average spreads, by rating and by year. The numbers presented are annual time series averages based on weekly cross-sections.

[Table I here]

The spreads on lower grade bonds are larger than the spreads on higher grade bonds, as would be expected, but all spreads tend to move together which can can be seen from the plots in Figure 1. The figure demonstrates the consistently larger spreads on lower grade bonds over 1997- 2004 and shows that all spreads tended to rise from early 1997 to late 2002, after which they all moved down again. Although it is not plotted here (for reasons of space), the stock market (S&P500) climbed upward until March 2000 and then declined until early 2002, remaining flat until the end of that year after which it recovered. The stock market level therefore shows an inverse relationship with bond spreads over this period, consistent with stocks and corporate bonds reflecting movements in the same risk premium. Four particular events which generated spikes in credit spreads are identified in Figure 1: the LTCM crisis of 8/1998; the dot.com bubble on Nasdaq during 2000; the terrorist attack on the World Trade Center of 9/2001; and the Worldcom default of 6/2002.

[Figure 1 here]

B. Measures of Bond Risk

Our aim is to relate credit spreads to systematic and idiosyncratic bond risks and in this section we explain the general methodology and the measures of risk to be used. Our approach is analogous to the familiar two-stage methodology used in asset pricing (Fama and MacBeth, 1973), except that in the second stage we use the promised bond returns contained in spreads rather than the actual, ex-post, bond returns. So in the first stage we estimate the sensitivity of individual bond returns to risk factors in time series and in the second stage we test whether the estimated factor-sensitivities can explain bond spreads in cross-section.

Systematic risk is conventionally estimated for a given security by regressing its return on the return of a suitably chosen index. However one complicating factor in such an approach, when applied to corporate bonds, is that changes in the risk-free term structure may affect individual bonds differently from the way in which they affect the bond index. To remove the influence of changes in the risk-free term-structure, we calculate the duration of the index in each period using its constituents and then calculate the return on a risk-free duration-matched portfolio of Treasury Bonds. We then subtract the matched risk-free return from the return of the index each week. The resulting series is an index of returns on the credit spread, designed by us specifically for the Merrill Lynch Corporate Master Index, and we call this the Return on the Systematic Credit Risk factor (*RSCR*)[11]. To be precise, the returns on the systematic credit risk factor, denoted as $RSCR_t$, are calculated as $(RI_t\text{-}rf_t)$, where RI_t is the return on the Merrill Lynch Corporate Master Index in week t and rf_t is the return on the risk-free portfolio with the same duration as the Corporate Master Index in week t.

To take account of the impact of changes in the riskless term structure on individual bonds, we could work with individual bond spreads by deducting the appropriate risk-free rate from each bond's return. However, we prefer to work with a less constrained specification in which individual bond returns are related to two variables: returns on the credit spread factor, $RSCR_t$; and changes in the risk-free rate at the maturity which matches the bond, denoted as $\Delta INT_{i,t}$. The term structure is estimated by interpolating the Federal Reserve constant-maturity Treasury yield series. The resulting equation for the i^{th} bond return in week t is,

$$RB_{it} = a_{i,t} + \beta_{i,t} RSCR_t + c_{i,t}\Delta INT_{i,t} + e_{i,t} \quad (1),$$

where $RB_{i,t}$ is the return of the bond, $RSCR_t$ is the return on the systematic credit risk factor, and $\Delta INT_{i,t}$ is the change in the risk-free rate corresponding to this bond's maturity. The systematic covariance risk for bond i in week t is measured by $\beta_{i,t}$. Idiosyncratic variance risk may also be a relevant variable for testing and we estimate it as the variance of the residuals $e_{i,t}$ from equation (1).

[11] The risk is systematic, because it is that which remains in a well-diversified portfolio of bonds.

A simple extension of the covariance risk model is to incorporate the size and book-to-market factors of Fama and French (as used for bonds by Elton et al, 2001). We then estimate the following equation,

$RB_{it} = a_{i,t} + \beta_{i,t}\, RSCR_t + c_{i,t}\Delta INT_{i,t} + s_{i,t}SIZE_t + h_{i,t}HML_t + e_{i,t}$ (2).

The values for the size ($SIZE_t$) and book-to-market (HML_t) factors are obtained from Kenneth French's website.

Our estimates of systematic coskewness risk are based on the approach of Kraus and Litzenberger (1976), that has been used more recently by Harvey and Siddique (2000). The returns on the systematic credit risk factor squared are added to equation (1) to give

$RB_{it} = a_{i,t} + \beta_{i,t}\, RSCR_t + \gamma_{i,t}\, RSCR_t^{\,2} + c_{i,t}\Delta INT_{i,t} + e_{i,t}$ (3),

where the systematic coskewness risk for bond *i* in week *t*, is measured by $\gamma_{i,t}$. We are also interested in idiosyncratic skewness risk, which is estimated from the skewness of the residual in equation (3). If the utility function of the representative investor includes skewness, then the larger and more negative are these (co)skewness factors, the greater is the negative skewness faced by the investor and the higher is the required return (i.e. the larger is the credit spread).

Another potential measure of systematic risk is downside beta. Following Ang, Chen and Xing (2006), the downside beta of a security may be measured by estimating its sensitivity to the market return when the market is in a "down" state. We define as "downside weeks" those weeks in which the gap between Moody's Seasoned Baa Corporate Bond Yield and the constant-maturity ten-year US government bond yield widens. These are weeks when credit conditions are worsening. We therefore measure downside betas by partitioning the previous year's weekly observations into downside weeks, based on the above criteria. Then, for the downside weeks alone, we run equation (1) to estimate the systematic downside covariance of each bond. In addition, idiosyncratic downside risk may be measured as the variance of the residuals from this regression. We also measure upside betas in an analogous way to downside betas, by partitioning the previous year's weekly observations into upside weeks.

Investors may be more concerned with extreme downside returns, rather than just with the simple downside returns which are estimated with downside betas. We therefore also consider the downside "tail risk" present in bond returns. To do so we identify the largest percentage negative return for a given bond during the previous 52 weeks. This is a simple non-parametric measure of the value-at-risk for the bond in question and the confidence level, given one year of weekly data, is at the 1/52 or 1.92% level. To partition this value-at-risk measure into its systematic and idiosyncratic components, we take the 52 weeks of data and exclude that week which has the largest negative return. Taking the remaining 51 weeks of data we run equation (1). Using this beta estimate and the values of the remaining independent variables in the value-at-risk week, we predict the size of the return in that week. This measures that part of the value-at-risk which is systematic, as it is that part which can be explained by factors common to all bonds. Then the difference between the actual return and predicted return on the bond in that week represents the idiosyncratic value-at-risk. The larger and more negative is the value-at-risk (either systematic or idiosyncratic), the more exposed is a given bond to tail risk and, potentially, the larger is the credit spread which an investor will require.

[Table II here]

Table II presents all of our measures of bond risk, both systematic and idiosyncratic, averaged by rating. To limit the influence of outliers on our subsequent analysis, we identify the lowest one per cent and highest one percent of all bond-week risk-measure observations. We then delete these from our sample, leaving 254,343 bond-week observations.[12] The numbers in the table represent time series averages of the

[12] This severe approach to cleaning the data, in which 19% of the observations are excluded, ensures that the results are not generated by outliers. By removing outliers, we are making it more difficult for tail measures, such as value-at-risk, to have an influence, so this is a conservative approach when testing for the influence of such measures. We have

414 weekly cross-sectional risk measures across our sample from January 1997 to December 2004. For some of the risk measures we get the expected relationship between risk and rating, i.e. as bond rating declines, estimated risk increases. This is the case for the systematic and idiosyncratic (co)variance measures (both downside and two-sided) and also for idiosyncratic value-at-risk. Interestingly, however, there is evidence that both systematic coskewness risk and idiosyncratic skewness risk, as well as systematic value-at-risk, are all greatest for the highest grade bonds.

C. Control Variables

In addition to our risk measures, several control variables that affect spreads need to be taken into account in the panel regressions. These can be split into ***common*** control variables that are the same for all bonds at each point in time and ***bond-specific*** control variables that represent characteristics of individual bonds. Common control variables are included to explain variation in the average level of spreads on all bonds in the time series, whereas bond-specific controls help to explain the differences in individual spreads for each weekly cross-section.

There are ***three common control variables*** in our regressions: the level of the term structure, the slope of the term structure, and the spread in yields between 30-day Eurodollar deposits and US Treasury bills. The level of the term structure is measured as the 5-year constant-maturity Treasury yield. From the perspective of a structural model (with firm value following a risk-neutral distribution), increases in risk-free interest rates should move the firm value away from the default boundary and reduce the overall level of spreads. We therefore expect the coefficient on level to be positive. The slope of the term structure is measured as the gap between the 20-year and three-month constant-maturity Treasury yields. The slope is often used to measure expectations about future interest rates (e.g. Cambell and Taksler, 2003; Collin-Dufresne et al, 2001) which should reduce spreads and so is expected to have a negative coefficient. The Eurodollar/Treasury difference in yields is intended to capture the flight-to-quality that occurs when there is a financial crisis, such as the four indicated in Figure 1. At such times the Eurodollar yield rises relative to the Treasury yield and the spread on all corporate bonds increases. This variable has been used by

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also checked that removing outliers does not meaningfully change average spreads by rating in our sample.

Campbell and Taksler (2003) and we expect it to have a positive coefficient.

There are ***eight bond-specific control variables*** in the panel regressions: the reciprocal of the market value of the issue, the coupon rate, the time to maturity, and five rating-related dummies. The reciprocal of the market value of the bond issue is used as a proxy for illiquidity and so is expected to have a positive coefficient. (The reciprocal is used, as it allows for a non-linear effect). The coupon rate affects positively the amount of tax to be paid and so is expected to have a positive coefficient. The time to maturity allows for the term structure of credit spreads and is expected to have a positive coefficient for high grade bonds (whose ratings can only fall over time) and a negative coefficient for low grade bonds (whose ratings can only rise over time). Turning to the five rating related dummies, the first two of these correct for any change in rating between the time series estimation of past risks and the current cross-section estimation of risk impacts. Dummy Higher (expected to be nagative) takes a value of one in a given week's cross-section if a bond's rating one year ago was higher than its rating in the current week. Dummy Lower (expected to be positive) takes a value of one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Finally, there is a need to control in cross-section for differences in expected losses due to default and we do this by including dummy variables for each of the three S&P ratings relative to AAA.

4. Empirical Results on the Determinants of Credit Spreads

In this section we examine how well our different bond risk measures (estimated from past individual bond returns in time series) explain current credit spreads in the cross-section. For the second-stage we use pooled cross-section/time series panel regressions, with the dependent variable being the level of spreads of given bonds in each week of the sample period.[13] [14] As our cross-sectional windows are overlapping (for 51

[13] We initially ran cross-section regressions for each of the 414 weeks separately and the results were similar to those from the panel regressions.

[14] It should be noted that because betas, gammas, downside betas and the loadings on size and book-to-market factors are estimated variables, our results may be subject to the well-known "errors-in-the-variables" bias. However, given the large sample, the effect is likely to be small.

weeks out of 52), calculating t-statistics in the traditional way would be biased and so we use a Newey-West correction. In the panel regressions, we permit the loadings on the risk factors to change each week (e.g. time-varying betas) to allow for the possibility that these risks may be priced differently through time. We do this by interacting time dummies with the risk factors.

There are three different types of risk to be considered. First we report regressions which only include systematic risk (Table III). Second, we report regressions which only include idiosyncratic (bond-specific) risk (Table IV). Third, we report regressions which include both systematic and idiosyncratic risk variables (Table V).

Table III, Panel A, presents the estimated parameters when systematic risk measures (and control variables) are used to explain credit spreads. We test whether each of our risk factors and their associated time dummies is statistically significant by using a Wald test, under the null hypothesis that a given risk factor and its associated time dummies are all jointly equal to zero. F-statistics from the Wald tests for each of the risk-factor coefficients are given in square parentheses.

We find that all of the **systematic risk factors** (reported in the top section of Table III, Panel A) in all five of the different specifications are significantly related to observed spreads and their coefficients have the expected signs. The regression in column (1) uses only systematic covariance, while column (2) uses the three Fama/French factors. Column (3) is the model with systematic covariance and systematic co-skewness (as in Harvey and Siddique, 2000). Column (4) has downside covariance and upside covariance (as in Ang et al, 2006). Column (5) has systematic value-at-risk. Each regression also includes the eight bond-specific control variables (middle part of Table III, Panel A) and the three common control variables (bottom part of Table III, Panel A).

Turning to the ***bond-specific* control variables** (in the middle part of the Table III, Panel A), market value, coupon, maturity and dummies have the expected signs and are of similar magnitude across the five regressions. They are all significant at the 1% level or better. Moving on to the **common control variables** (at the bottom of the table), we find that the level of the term structure is not significant, but the slope of the term structure and the Eurodollar/Treasury spread are both significant (with the latter having an unexpected negative coefficient).

Although each of the systematic risk measures is *statistically* significant in explaining the variance of the credit spread, what interests us is their implied contribution to size of spread, since that is the variable of *economic* significance. To understand this, we multiply each coefficient from each panel regression by its average size for each week and for each rating, then we average the results across the whole set of weeks in the sample. This gives us the proportion of the spread which is explained by each risk factor. Table III, Panel B, presents the results for each of the equations (1) to (5). For example, from the first row in Table III, Panel B we can see that systematic covariance (the CAPM model) can explain only about 4 basis points (5%) of AAA spreads and 19 basis points (10%) of BBB spreads. Using equation (2), which is the Fama/French model, we find that SMB and HML have no economically significant role in explaining the credit spreads of bonds. [15] The model which includes co-skewness, equation (3), does no better in explaining the level of spreads than does the simple covariance model of equation (1). The downside and upside covariance (beta) model of equation (4) can also only generate about 6 basis points of spread for AAA bonds and 18 basis points of spread for BBB bonds. The only systematic risk which we find to have a sizeable impact on AAA bonds is the systematic value-at-risk (equation (5)). For AAA bonds systematic value-at-risk explains 21 basis points (26%) of the credit spread, but it explains only 18 basis points (10%) of the credit spread for BBB bonds.

The other factors making an economic contibution to spreads are the control variables, for which the results are reported in Table III, Panel C, based upon Equation 2 which uses the Fama/French set of risk factors. The results indicate that: liquidity (proxied by market value of issue) contributes 12 basis points to A-rated spreads (10% of the spread); tax (proxied by the coupon rate) contributes 32 basis points to A-rated spreads

[15] A result which is different from that in Elton et al (2001), possibly because they use a residual spread after deducting tax and coupon effects.

(27% of the spread); and maturity contributes 9 basis points to the A-rated spread (8% of the spread). These results for tax are a little smaller than those which Elton et al (2001, page 273) report for A-rated bonds, who find that 36% of the A-rated spread is due to tax. Note that although we only make the attibution to spreads of control variables in Table IIIC using Equation 2, the coefficients on these variables are similar across equations (1) to (5) in Table III, Panel A and so the results from different specifications would be similar.

Table IV, Panel A, gives the results from panel regressions which use only idiosyncratic (firm-specific) risk factors and Table V, Panel A, gives the results when both systematic and bond specific risk factors are used to explain spreads. In both of these tables all of the risk factors are statistically significant and the control measures have signs and magnitudes which are similar to those already noted in Table III, Panel A. The proportion of the variance of spreads explained by the idiosycratic-risk factors in Table IV, Panel A, as indicated by the pseudo R-squared for each equation, is 31-34% whereas the equivalent in Table III, Panel A was less, being 19-28%.

Turning to Table IV, Panel B, it is evident that **idiosyncratic-risk factors** explain a far larger proportion of the spread than do their systematic counterparts in Table III, Panel B. For example, the idiosyncratic covariance in Table V, Panel B generates 24% of the spread for A-rated bonds and 40% (73 basis points) for BBB-rated bonds, whereas the systematic covariance in Table III, Panel B generates on average only 9% of the spread for A-rated bonds. Idiosyncratic coskewness (equation (2)) also has a measurable impact, resulting in a reduction of spreads of 11 basis points (9%) for A-rated bonds and a similar level of impact for bonds of other ratings. Note that positive skewness is a desirable attribute, so this result is entirely to be expected. However, it is the idiosyncratic value-at-risk (equation (4)) which has the most impressive impact on spreads, ranging from 29 basis points (38%) for AAA bonds to 51 basis points (28%) for BBB bonds.

Moving on to Table V, it shows in Panel A that when **systematic and idiosyncratic risk factors** are both included in the panel regressions, they are both statistically significant. However, Table V, Panel B shows that idiosyncratic (bond-specific) risk is far more important in determining spreads than is systematic (market-related) risk. For example, in Equation (1) at the top of Table V, Panel B, systematic covariance is shown to generate 3% of the A-rated spread, but idiosyncratic variance explains more than seven times as much: 23% of the A-rated spread. The most impressive results in Table VB relate to value-at-risk, at the bottom of the table (specified as Equation (4)). For AAA bonds the systematic value-at-risk explains 12% of the spread (9 basis points), but the idiosyncratic value-at-risk explains 52% of the spread (41 basis points). The equivalent values for BBB-rated bonds are 4% and 38% respectively. So the table indicates that value-at-risk (systematic and idiosyncratic together) can explain 64% of AAA spreads, 57% of AA-rated spreads, 47% of A-rated spreads and 42% of BBB-rated spreads.

We noted earlier that the “puzzle” of large spreads is greatest for AAA-rated bonds. Table V, Panel C, indicates that for AAA bonds the effects of size (liquidity) and coupon (tax) are smaller than the effects measured previously in Table III, Panel C. This is because some of the spread formerly attributed to these control variables is now attributed to the risk factors. For AAA bonds the tax and liquidity components of the spread are now estimated (in Table V, Panel C) to be 11% and 10% respectively, whereas in Table III, Panel C they were estimated to be 39% and 13% respectively. The effect of maturity is actually somewhat higher for AAA bonds in Table V, Panel C (21%) than it was in Table III, Panel C (17%). If we add together for AAA bonds the value-at-risk, tax, liquidity and maturity effects, they now generate 64+11+10+21 = 106% of the average spread. The puzzle of there being an exceptionally large spread on highly-rated bonds has disappeared, mainly because of the effect of idiosyncratic bond value-at-risk (52% of the spread).

5. Is the explanatory power of idiosynratic bond value-at-risk just an equity-volatility effect?

Campbell and Taksler (2003) find that the idiosyncratic volatility of equity returns plays an important role in explaining the cross section of credit spreads. Using a panel of corporate bonds from 1995 to 1999, they show that equity return volatility has as much explanatory power in explaining the variance of credit spreads as do differences in ratings. Our study so far has shown that bond idiosyncratic value-at-risk makes a substantial contribution to explaining the level of credit spreads in cross-section. However the explanatory power of this risk factor might simply be due to its correlation with equity return volatility.

In order to test this hypothesis, we match as many as possible of the weekly observations on our bond data with the equity returns of the same companies. Of the 254,343 bond-week observations in our original data we are able to match 149,999 with their weekly equity returns. [16] Working with this matched set of data, we then examine whether idiosyncratic value-at-risk is displaced by idiosyncratic equity volatility, the latter being the variable used by Campbell and Taksler (2003). We measure the idiosyncratic equity volatility as the standard deviation of weekly equity returns in excess of the CRSP value-weighted index return over the previous 52 weeks. Table VI, Panel A, gives the estimated coefficients from our panel regressions. We find that equity volatility has a statistically significant influence in explaining spreads for all of the five specifications used. Turning to Table VI, Panel B, it appears that idiosyncratic equity volatility by itself (equation (1)) can generate 37 basis points (47%) of spread for AAA bonds and about the same basis points for bonds of other ratings. When equity volatility is included together with bond value-at-risk (equation (5), reported at the bottom of Table VI, Panel B), then equity volatility generates 39% of the AAA spread, idiosyncratic bond value-at-risk generates 53% of the AAA spread and systematic bond value-at-risk generates 14% of the AAA spread. For lower grade, BBB bonds, the three factors generate 20%, 37% and 5% of the spread, respectively. The conclusion is that idiosyncratic equity volatility is an economically important influence on bond spreads, but it is less important than bond idiosyncratic value-at-risk. As will be discussed in section 7 of this paper, both of these variables depend on the risk-neutral distribution of firm value, but we find that idiosyncratic bond value-at-risk has a larger impact on size of spread than idiosyncratic equity volatility across all classes of bond.

6. Robustness Tests

In this section of the paper we check on the robustness of the results by making three further analyses. In the first we introduce equity value-at-risk as a risk factor, to see if there is something special about value-

[16] The data on equity returns are from the CRSP database.

at-risk measures in determining bond spreads. In the second we divide the sample into two halves and examine the time series stability of the results. In the third we measure the bond value-at-risk with shorter (26-week) and longer (104-week) sets of data, to see if that changes the results.

Value-at-risk is a particular downside tail measure. In the structural approach to modelling credit risk, a corporate bond is valued as a risk-free bond minus the value of an out-of-the-money put option on firm value. Valuing the put depends on assessing the size of the tail of the firm value distribution, which might be proxied by the value-at-risk on the firm's equity. Equity value-at-risk might therefore be significantly related to bond spreads. In Table VII we include (in equations (1) to (3)) both the systematic value-at-risk of a firm's equity and the idiosyncratic value-at-risk of a firm's equity, as independent variables in panel regressions. We also report again for comparison, in column (4), the result from Table VI which uses systematic bond value-at-risk, idiosyncratic bond value-at-risk, and equity volatility.

As in previous regressions, all of the coefficients on the risk variables in Table VII, Panel A, are statistically significant. However, the influence of equity value-at-risk is rather small, as seen in Table VII, Panel B. The top two lines of the table show that together systematic equity value-at-risk and idiosyncratic equity value-at-risk explain only 7 - 13% of observed spreads across different rating classes of bond. In the other specifications (equations (2) and (3)) their influence is not much larger. These results may be contrasted with the influence of bond value-at-risk and idiosyncratic equity volatility in equation (4), which together have an impact on spreads which is many times greater. So equity value-at-risk does not appear to be a useful variable for explaining bond spreads. There is therefore something special about bond value-at-risk and spreads which is not related to equity value-at-risk.

In Table VIII we test whether our results are stable over time,. Panels A1 and B1 report regressions with four different specifications which have been estimated using the first half of the data and Panels A2 and B2 do the same for the second half of the data. The implications for what causes spreads do not change across the two time periods: in both of Panels B1 and B2 the largest influence is bond idiosyncratic value-at-risk.

In the third robustness test, the bond value-at-risk (both systematic and idiosyncratic) is estimated with 26 weeks of data and with 104 weeks of data, as compared with the 52 weeks of data in the original regressions. The results in Table IX confirm that whether 26 or 104 weeks of data are used (rather than the 52 weeks in previous tables), the results are not much affected.

7. Why is Bond Idiosycratic Value-at-Risk So Closely Related to Spreads?

We need to explain two of the empirical results. First, why is ***idiosyncratic*** risk far more important for bond spreads than is systematic risk? Second, why is ***bond idiosyncratic value-at-risk*** more-closely related to credit spreads than is any other idiosyncratic measure which we have investigated?

In answer to the first question, 'why idiosyncratic risk', the holder of a credit risky bond has a position equivalent to being long of a risk-free bond and being short of a put option on the firm's value, with an exercise price equal to the face-value of the credit risky bond (Merton, 1974). As the price of such a put option depends on the total volatility of firm value, both systematic and idiosyncratic risk are relevant, but idiosyncratic risk is much larger.[17] Campbell and Taksler (2003) focus on the idiosyncratic volatility of the firm's equity as a proxy for the volatility of firm value under risk-neutrality. We focus on the idiosyncratic volatility of bond prices as a proxy for the shape of the risk-neutral distribution of firm value. In both cases idiosyncratic risk is relevant to pricing because the underlying feature being proxied is the risk-neutral distribution of firm value.

The answer to the second question, 'why bond idiosyncratic value-at-risk', is more complicated. We have compared bond idiosyncratic VaR as an explanatory factor for the size of spread with several alternatives, including: equity idiosyncratic VaR, equity idiosyncratic volatility, and bond downside idiosyncratic variance. Bond idiosyncratic VaR generates larger spreads than any of these alternatives and it is clear that the equity based measures are not as convincing as the bond based measures. There is a good reason why

[17] In Table 2 the estimated idiosyncratic variance of bond returns is about ten times as large as the systematic variance of bond returns, for all rating classes.

the bond risk measures should outperform the equity risk measures in relation to generating spreads. Both bonds and equities depend on the underlying firm value, with a risky bond price equal to a risk-free bond less a put option on firm value and an equity price equal to a call option on firm value. When we sample investment-grade bond prices, we are drawing from the risk-neutral distribution of firm value in the extreme left hand quantile, because the bond's put option is hugely out-of-the-money. When we sample equity prices, we are drawing from the same risk-neutral distribution of firm value, but we are now pricing a call option which is hugely in-the-money (as the equity price for a company with investment-grade debt is generally about five times the face value of the debt outstanding).[18] It is well known from studies of equity index options, such as those by Buraschi and Jackwerth (2001) and Rosenberg and Engle (2002), that the pricing kernel (which transforms the objective density into the risk-neutral density) places a very high value on avoiding large losses. Equivalently, we know that out-of-the-money put options on equity indices have extraordinarily high prices, suggesting an extreme level of risk aversion in relation to bad states of nature. The put options which underlie credit risky bonds are deep out-of-the-money options, so they reflect that same segment of the pricing kernel – they are priced from a segment of the risk-neutral distribution of returns which is highly skewed on the downside. When we relate spreads to risks from bond prices, we are capturing the left-skewness of the risk-neutral distribution directly, but when we relate spreads to risks from equity prices, we are sampling from the main body of the risk-neutral distribution of firm value. To draw an analogy, if the spot price of Microsoft's shares is $36 and we estimate the volatility from recent price movements, we are unlikely to be able to use that volatility to price (with any accuracy) hugely out-of-the-money 10-year put options on Microsoft which have an exercise price of $9. Using equity volatility to price bonds is like doing that.

Having explained why bond-risk measures are more closely related to bond spreads than are equity-risk measures, it remains to explain why bond VaR is a more important variable for spreads than is bond downside variance. Both are quantile measures relating to the left-hand side of the distribution of bond returns, but the VaR is a measure of the extreme left-hand quantile whereas downside variance measures the size of the whole left-hand half of the distribution. The empirical VaR depends not only on the

[18] Companies with AA-rated bonds have a typical leverage of 21% (see Huang and Huang, 2003).

variance on the left-hand side of returns, but also on the skewness and kurtosis of the risk-neutral distribution. The put option on firm value which determines the price of the credit risky bond has a negative delta and a negative gamma ($\partial P_b/\partial V < 0$, $\partial^2 P_b/\partial V^2 < 0$), so a fall in firm value induces an increase in the put value at an increasing rate. The bond VaR captures this non-linearity more effectively than does downside bond variance and for that reason it may relate more closely to the put value which determines the credit spread.

8. Conclusions and Implications

This paper investigates the factors which determine credit spreads on corporate bonds, using a two-stage approach. In the first stage we use time series to estimate the rolling sensitivity of individual bond returns to a set of risk factors, including covariance with the index (i.e. beta), coskewness and downside covariance (i.e. downside beta). In the second stage we relate these estimated sensitivities to credit spreads for the next period, in cross-section. Our method differs from the traditional Fama/McBeth procedure, in that we use estimated sensitivities in order to predict **credit spreads** rather than to predict **bond returns**. As credit spreads reflect "promised" returns, they include the forward-looking risk premium and this is a much less noisy measure of the risk premium than is available from using ex-post bond returns. An asset pricing study of corporate bonds can therefore be done with less than a decade of data, whereas a study of equities would need several decades of data for equivalent precision.

What we find is that systematic, index related, risks have very little influence on the size of credit spreads. For example, the three Fama/French factors can only generate about 9% of the observed A-rated spread and 5% of the AAA-rated spread. Coskewness and downside betas fare little better. Surprisingly, idiosyncratic risk has a much larger influence on the size of spread than does systematic risk, despite its potential for being diversified away. For example, idiosycratic bond variance can generate 24% of the A-rated spread and 25% of the AAA-rated spread. An even more effective measure of risk for bond pricing is found to be idiosycratic bond value-at-risk, which can generate 30% of A-rated spreads and 38% of AAA-rated spreads.

If a structural approach to bond pricing is taken (following Merton, 1974), then the total volatility of firm value (systematic plus idiosyncratic) should be the key variable for determining spreads. In line with this viewpoint, Campbell and Taksler (2003) demonstrate that equity volatility can explain a significant proportion of the variance of bond spreads. However they also show that it is idiosyncratic (rather than systematic) equity volatility which is the main driver. When we use idiosyncratic equity volatility by itself in our analysis, it has an impact which is smaller in magnitude than that of idiosyncratic bond value-at-risk. When the two variables are considered together in the same regression, it is the idiosyncratic bond value-at-risk which has the larger impact on spreads. Robustness tests, in which the value-at-risk is measured over different horizons, or the sample is cut into two halves, or we include a value-at-risk measure for equity, do not change these results.

The "puzzle" of credit spreads is that they are so large, particularly those of AAA-rated bonds for which default is extremely unlikely. Our regessions include not only risk factors but also control factors to measure the effects of liquidity and tax. From the regressions we can attribute the following approximate components of the AAA-rated spread: tax 11%, liquidity 10%, bond maturity 21%, bond systematic value-at-risk 12%, and bond idiosyncratic value-at-risk 52%. Adding these components together we "explain" 106% of the average spread for AAA-rated bonds. If we go through the same attribution for BBB-rated bonds, it is on average: tax 5%, liquidity 5%, bond maturity 8%, bond systematic value-at-risk 4%, and bond idiosycratic value-at-risk 38%, leading to a total of 60%. However, for BBB bonds there is an extra default component relative to AAA bonds (measured with a dummy variable in our study) of 77 basis points (43% of the spread), so the grand total for BBB bonds due to all factors is estimated to be 60+43 = 103%. Idiosyncratic bond value-at-risk is therefore the largest single contributor to spreads for bonds in the AAA to BBB range and, together with tax, liquidity, maturity and default, can generate plausible spreads across these ratings.

It remains to explain why downside tail risk on bonds is so important for credit spreads. We think that it is likely to be used by investors to judge the appropriate risk premium, because it is an out-of-the money measure relating to the risk-neutral distribution of firm value. The bond spread is determined by the value of an out-of-the-money put on firm value. We know from equity-index options and CDOs that out-of-the-money puts command extraordinarily large premia (i.e. there is a steeply downward sloping volatility smile in equity-index options and a similarly large correlation sneer in CDOs), so the extraordinarily large spread on AAA-rated bonds is a reflection of the extreme out-of-the-money nature of their intrinsic put options. In other words, the pricing kernel places great value on positive outcomes in particularly bad states of nature; defaults on AAA-rated bonds would be undesirable events in precisely those states. We conclude that the existence of a large risk-premium for extreme downside movements is the most likely explanation for the credit spread puzzle.

References

Amato, J., and E.Remolona (2003), “The Credit Spread Puzzle.” Quarterly Review, Bank for International Settlements, December, 51-63.

Amato, J.. and E.Remolona (2005), “The Pricing of Unexpected Credit Losses.” Working Paper, Bank for International Settlements.

Anderson, R., and S. Sundaresan (1996), "Design and Valuation Of Debt Contracts." *Review of Financial Studies*, 9, (1), 37-68.

Ang,A.; J.Chen; and Y. Xing (2006), “Downside Risk”, *Review of Financial Studies*, 19 (4), 1191-1239.

Berd,A.; R. Engle; and A. Voronov (2005), “The Underlying Dynamics of Credit Correlations.” Working Paper, New York University.

Bharath, S., and T. Shumway (2004), “Forecasting Default With the KMV-Merton Model.” Working Paper, University of Michigan.

Bliss, R., and N. Panigirtzoglou (2004), “Option-implied Risk Aversion Estimates.” *Journal of Finance*, 59, 407-446.

Bollen, N., and R. Whaley (2004), “Does net buying pressure affect the shape of implied volatility functions?” *Journal of Finance*, 59, 711-753.

Buraschi, A., and J. Jackwerth (2001), "The Price of A Smile: Hedging and Spanning In Option Markets." *Review of Financial Studies*, 14, 495-527.

Campbell,J., and G.Taksler (2003), “Equity Volatility and Corporate Bond Yields.” *Journal of Finance,* 58 (6), 2321-2350.

Campello, M.; L.Chen; and L.Zhang (2007), “Expected Returns, Yield Spreads and Asset-Pricing Tests.” *Review of Financial Studies*, forthcoming.

Chen,L.; P.Collin-Dufresne; and R.Goldstein (2006), “On the Relation Between Credit Spread Puzzles and the Equity Premium Puzzle.” Working Paper, University of California, Berkeley.

Chen,L.; D.Lesmond; and J.Wei (2007), “Corporate Yield Spreads and Bond Liquidity.” *Journal of Finance*, 62 (1), 119-149.

Collin-Dufresne, P., and R.Goldstein (2001), "Do Credit Spreads Reflect Stationary Leverage Ratios?" *Journal of Finance*, 56, 1929-1957.

Collin-Dufresne,P.; R.Goldstein; and J.Helwege (2003), “Is Credit Event Risk Priced? Modelling Contagion via the Updating of Beliefs.” Working Paper, Carnegie Mellon University.

Collin-Dufresne,P., R.Goldstein and J.Martin (2001), “The Determinants of Credit Spread Changes”, *Journal of Finance*, 56 (6), 2177-2207.

Cooper,I., and S.Davydenko (2003), “Using Yield Spreads to Estimate Expected Returns on Debt and Equity.” Working Paper, London Business School.

Cremers,M.; Driessen,J.; and P.Maenhout (2007), “Explaining the Level of Credit Spreads. Option Implied Jump-risk Premia in a Firm-value Model”, *Review of Financial Studies*, forthcoming.

De Jong, F.; and J. Driessen (2006), “Liquidity Risk Premia in Corporate Bond Markets.” Working Paper, University of Amsterdam.

Driessen,J. (2005), Is Default Event Risk Priced in Corporate Bonds?" *Review of Financial Studies*, 18, 165-195.

Elton,E.; M.Gruber; D.Agrawal; and C.Mann (2001), "Explaining the Rate Spread on Corporate Bonds." *Journal of Finance*, 56 , 247-277.

Eom,Y.; J.Helwege; and J.Huang (2004), "Structural Models of Corporate Bond Pricing: An Empirical Analysis." *Review of Financial Studies*, 17 , 499-504.

Ericsson, J., and O.Renault (2005), "Liquidity and Credit Risk." *Journal of Finance,* 61, 2219-2250.

Fama, E., and J.MacBeth (1973), "Risk, Return, and Equilibrium: Empirical Tests." *Journal of Political Economy*, 81, 607-636.

Fama, E., and K. French (1993), "Common Risk Factors in the Returns On Stocks and Bonds." *Journal of Financial Economics*, 33, 3-56.

Gebhardt,W.; S.Hvidkjaer; and B.Swanimathan (2005), "The Cross-section of Expected Corporate Bond Returns: Betas or Characteristics?" *Journal of Financial Economics*, 75, 85-114.

Goyal, A., and P. Santa Clara (2003), "Idiosyncratic Risk Matters!" *Journal of Finance*, 58, 975-1007.

Han,B. (2005), "Limits of Arbitrage, Sentiment and Pricing Kernel", Working Paper, Ohio State University.

Harvey,C., and A.Siddique (2000), "Conditional Skewness in Asset-Pricing Tests", *Journal of Finance*, 55, 1263-1295.

Huang,J., and M.Huang (2003), "How Much of the Corporate-treasury Yield Spread is Due to Credit Risk?" Working Paper, Stanford.

Kraus, A., and R.Litzenberger (1976), "Skewness Preference and the Value of Risk Assets." *Journal of Finance*, 31, 1085-1100.

Leland, H., and K.Bjerre Toft (1996), "Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads." *Journal of Finance*, 51, 987-1019.

Longstaff, F., and E.Schwartz (1995), "A Simple Approach to Valuing Risky Fixed and Floating Rate Debt." *Journal of Finance*, 50, 789-819.

Longstaff,F.; S. Mithal; and E.Neis (2005), "Corporate yield spreads: default risk or liquidity?" *Journal of Finance*, 60, 2213-2253.

Merton, R.C. (1974), "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." *Journal of Finance*, 29, 449-470.

Perraudin,W., and A. Taylor (2003), "Liquidity and Bond Market Spreads." Working Paper, Bank of England.

Rosenberg, J., and R.Engle (2002), "Empirical Pricing Kernels." *Journal of Financial Economics*, 64, 341-372.

Saita, L. (2006), "The Puzzling Price of Corporate Default Risk." Working Paper, Stanford University.

Table I: Bond Sample Details

The following table presents details of our sample. The number of bonds in Panel A are calculated as those alive at the start of each year in each rating category. Yearly by rating average spreads in Panel B are calculated as annual time series averages based on weekly cross-sections. Average coupon rate, bond issue size and time to maturity across bond-weeks by rating are presented in Panel C.

Panel A: Number of Bonds by Rating Year

Rating	1997	1998	1999	2000	2001	2002	2003	2004	*average*	*share of sample*
AAA	16	10	11	12	15	20	22	25	*17*	*2.6%*
AA	92	59	62	79	95	103	70	74	*79*	*12.3%*
A	356	236	318	370	376	326	367	390	*342*	*53.3%*
BBB	198	135	165	182	196	246	246	270	*205*	*31.9%*
All bonds	662	439	556	643	682	695	705	759	*643*	*100.0%*

Panel B: Average Bond Spreads by Rating Year

Rating	1997	1998	1999	2000	2001	2002	2003	2004	*average*
AAA	42.35	62.92	80.39	112.17	99.18	93.37	73.21	60.16	77.97
AA	49.51	81.66	92.73	141.86	125.68	114.56	75.81	56.43	92.28
A	62.90	96.80	110.44	165.16	156.29	149.22	108.87	92.34	117.75
BBB	84.06	138.32	161.97	230.48	247.77	265.20	202.42	132.08	182.79
All Bonds	59.70	94.92	111.38	162.42	157.23	155.59	115.08	85.25	117.70

Panel C: Characteristics of bond sample averaged by rating

Characteristic	AAA	AA	A	BBB
Market value of bond issue ($m)	278.09	253.01	247.00	244.78
Coupon rate (percent)	6.97	7.04	7.14	7.53
Time to maturity (years)	13.45	10.19	9.89	11.61

Figure I: Spreads by Rating over Sample Period

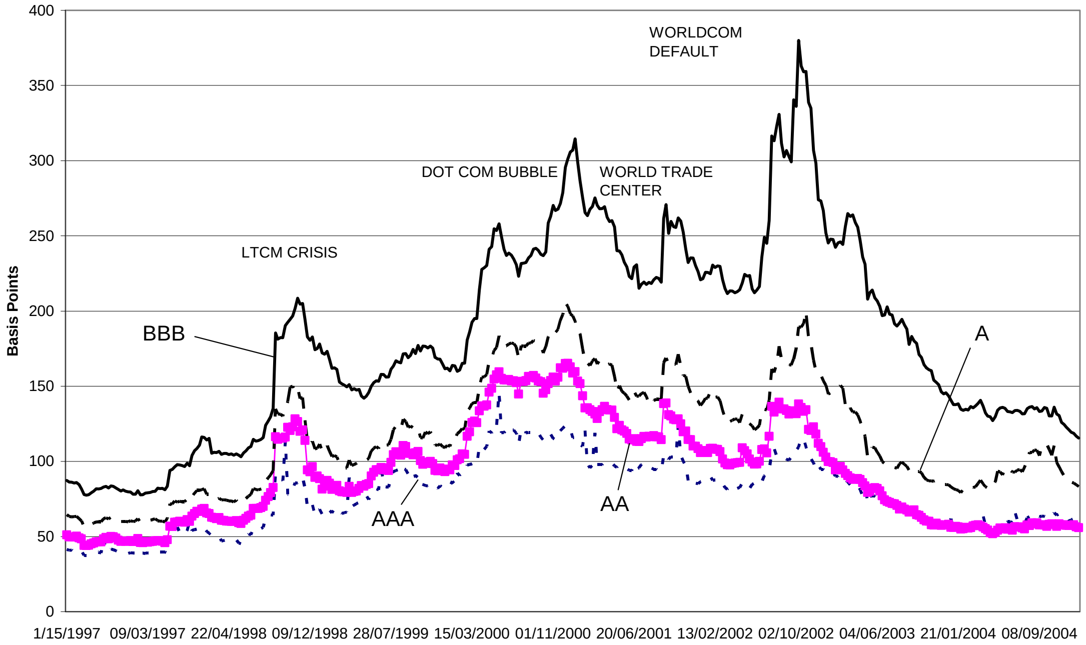

Table II: Bond Risk Measures

This table shows different measures of bond risk by rating category in our sample after removing outliers. Measures of risk are calculated from our baseline regression specification. This involves regressing individual bond returns over the previous 52 weeks on a systematic credit risk factor (the Merrill Lynch corporate master index returns in excess of the return of the duration matched risk-free portfolio return) and the change in risk-free interest rate corresponding to that bond's maturity. The systematic covariance is the slope coefficient on the systematic credit risk variable and the bond specific variance is the variance of regression residuals. Size and value loadings are based on this regression, except that additional weekly Fama and French factors are included. Systematic coskewness involves estimating our baseline specification with the addition of the systematic credit risk factor squared and bond specific skewness is the skewness of residuals from this regression. The slope coefficient on the systematic credit risk variable from estimating our baseline specification, over those weeks in the previous year where the gap between Moody's Seasoned Baa Corporate Bond Yield and the constant maturity ten-year US government bond yield widens, is used to measure downside systematic variance. The variance of residuals from this regression is used to estimate downside bond idiosyncratic variance. Upside systematic variance and the bond idiosyncratic variance measures are calculated in exactly the same way, except that they are estimated over weeks in the previous year where the gap between Moody's Seasoned Baa Corporate Bond Yield and the constant maturity ten-year US government bond yield narrows. To calculate our value-at-risk measures, we run our baseline specification taking the previous 52 weeks of data and excluding the largest negative return observation. Using this beta estimate and the values of the remaining independent variables in the value-at-risk week, we predict the size of the return in the omitted week. This is the systematic value-at-risk of the bond concerned. The difference between the actual returns and predicted returns in that week represents the specific value-at-risk of the bond. Numbers in the tables are time-series averages of corresponding quantities calculated for each of the 414 weekly cross-sections

Risk Measures	AAA	AA	A	BBB
Systematic covariance	0.593	0.656	0.789	1.162
Idiosyncratic variance (x1000)	0.059	0.070	0.081	0.173
Size risk	0.022	0.007	0.016	0.022
Book-to-Market risk	0.000	0.006	0.003	0.006
Systematic coskewness	-41.088	-2.757	-30.343	-32.034
Idiosyncratic skewness	-2.514	-2.445	-2.353	-1.827
Downside systematic variance	0.503	0.639	0.716	1.077
Downside idiosyncratic variance (x1000)	0.057	0.068	0.075	0.171
Upside systematic variance	0.633	0.597	0.828	1.165
Upside idiosyncratic variance (x1000)	0.052	0.065	0.076	0.153
Systematic value at risk	-0.009	-0.007	-0.007	-0.007
Idiosyncratic value at risk	-0.028	-0.032	-0.033	-0.044

Table III: Results Using Systematic-Risk of Bonds

The tables below present the results of panel regressions of credit spreads on different systematic risk measures and control variables. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors to vary over time. Panel A presents the parameter estimates for our risk factors averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor and its associated time dummies are all jointly equal to zero are presented in square parentheses next to each of our risk factor parameters. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A: Parameter estimates

Independent variable	(1)		(2)		(3)		(4)		(5)	
Systematic covariance (+)	**18.081**	**[372.2]**	**17.438**	**[340.32]**	**17.431**	**[349.43]**				
Size risk (-)			**24.723**	**[22.13]**						
Book-to-Market risk (+)			**75.878**	**[39.04]**						
Systematic coskewness (-)					**0.013**	**[37.84]**				
Downside systematic variance (+)							**17.778**	**[166.8]**		
Upside systematic variance (-)							**-0.735**	**[90.68]**		
Systematic value at risk (+)									**-2257.72**	**[95.63]**
Bond Specific Controls										
1/market value (+)	**3052.1**	**(9.25)**	**2972.0**	**(9.14)**	**3143.3**	**(9.51)**	**3151.7**	**(9.53)**	**3354.3**	**(9.60)**
coupon rate (+)	**4.205**	**(9.09)**	**4.424**	**(9.68)**	**4.357**	**(9.55)**	**4.395**	**(9.48)**	**3.948**	**(8.20)**
time to maturity (+/-)	**0.724**	**(12.22)**	**0.720**	**(12.26)**	**0.727**	**(12.28)**	**0.748**	**(12.88)**	**1.089**	**(23.02)**
Dummy higher (-)	**-3.768**	**(-4.33)**	**-3.260**	**(-3.77)**	**-3.792**	**(-4.45)**	**-4.083**	**(-4.72)**	**-3.112**	**(-3.26)**
Dummy lower (+)	**29.581**	**(17.09)**	**28.702**	**(16.54)**	**29.762**	**(17.15)**	**30.309**	**(17.44)**	**34.598**	**(19.15)**
Dummy AA (+)	**5.548**	**(4.00)**	**4.645**	**(3.30)**	**4.547**	**(3.35)**	**5.495**	**(4.07)**	**11.391**	**(7.79)**
Dummy A (+)	**28.098**	**(17.35)**	**28.063**	**(17.83)**	**27.708**	**(17.59)**	**28.139**	**(18.02)**	**35.465**	**(22.11)**
Dummy BBB (+)	**78.025**	**(49.43)**	**77.616**	**(49.16)**	**77.226**	**(49.82)**	**78.069**	**(50.44)**	**85.646**	**(52.44)**
Common Controls										
5 year Treasury yield (-)	0.002	(0.00)	0.703	(0.86)	-0.094	(-0.11)	-0.434	(-0.52)	-1.708	(-2.55)
20 year-3 month Treasury yield (-)	**-8.758**	**(-13.59)**	**-8.823**	**(-14.90)**	**-9.254**	**(-14.85)**	**-10.686**	**(-17.49)**	**-8.188**	**(-16.11)**
30 day Eurodollar-Treasury (+)	**-19.621**	**(-12.42)**	**-20.470**	**(-13.22)**	**-19.619**	**(-12.53)**	**-21.567**	**(-13.78)**	**-24.707**	**(-17.61)**
Constant	**56.059**	**(9.85)**	**51.263**	**(9.66)**	**56.912**	**(10.12)**	**63.116**	**(11.56)**	**62.142**	**(12.68)**
Number of observations	254343		254343		254343		254343		254343	
Pseudo R-squared	0.263		0.2774		0.2731		0.2651		0.1927	

Panel B: Average weekly spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation		AAA	AA	A	BBB
1	Systematic covariance	3.636	9.381	10.497	19.075
		5%	10%	9%	10%
2	Systematic covariance	3.997	9.790	10.884	18.878
		5%	11%	9%	10%
	Size risk	0.468	0.407	0.293	1.097
		1%	0%	0%	1%
	Book-to-Market risk	-0.668	0.935	0.587	1.408
		-1%	1%	0%	1%
3	Systematic covariance	3.858	9.559	10.625	19.014
		5%	10%	9%	10%
	Systematic coskewness	-1.617	-0.349	-1.128	-0.164
		-2%	0%	-1%	0%
4	Downside systematic variance	5.692	8.815	9.779	17.659
		7%	10%	8%	10%
	Upside systematic variance	-5.401	-1.783	-1.930	-1.897
		-7%	-2%	-2%	-1%
5	Systematic value at risk	20.574	17.233	15.061	17.759
		26%	19%	13%	10%

Panel C: Average weekly spread contribution in basis points and as a percentage of the average by rating spread of selected control variables

	AAA	AA	A	BBB
Coupon	30.571	31.742	31.778	33.930
	39%	34%	27%	19%
Time to maturity	13.120	10.494	9.181	11.386
	17%	11%	8%	6%
Size	10.106	11.508	11.953	12.258
	13%	12%	10%	7%

Table IV: Results Using Idiosyncratic Risk of Bonds

The tables below present the results of panel regressions of credit spreads on different idiosyncratic (bond-specific) risk measures and control variables. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors to vary over time Panel A presents the parameter estimates for our risk factors averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor and its associated time dummies are all jointly equal to zero are presented next to each of our risk factor parameters in square parentheses. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A: Parameter estimates

Independent variable	(1)		(2)		(3)		(4)	
Idiosyncratic variance (1000s) (+)	**299.544**	**[692.33]**	**430.746**	**[323.16]**				
Idiosyncratic skewness (-)			**3.573**	**[61.76]**				
Downside idiosyncratic variance (1000s) (+)					**157.455**	**[208.21]**		
Upside idiosynctratic variance (-)					**140.484**	**[103.11]**		
Idiosyncratic value at risk (+)							**-1036.252**	**[604.59]**
Bond Specific Controls								
1/market value (+)	**2275.4**	**(7.49)**	**2459.4**	**(8.27)**	**2315.568**	**(7.62)**	**2377.547**	**(7.71)**
coupon rate (+)	**2.243**	**(4.99)**	**2.195**	**(4.89)**	**2.368**	**(5.28)**	**2.311**	**(4.96)**
time to maturity (+/-)	**0.310**	**(4.89)**	**0.230**	**(3.81)**	**0.346**	**(5.46)**	**1.230**	**(23.69)**
Dummy higher (-)	**-4.425**	**(-5.69)**	**-6.067**	**(-8.01)**	**-4.292**	**(-5.51)**	**-5.979**	**(-7.61)**
Dummy lower (+)	**22.997**	**(14.52)**	**22.126**	**(14.16)**	**23.633**	**(14.84)**	**27.288**	**(16.66)**
Dummy AA (+)	**6.250**	**(5.49)**	**4.053**	**(3.49)**	**6.108**	**(5.34)**	**5.508**	**(4.27)**
Dummy A (+)	**28.904**	**(21.37)**	**27.877**	**(20.54)**	**28.997**	**(21.21)**	**31.408**	**(21.43)**
Dummy BBB (+)	**71.020**	**(53.90)**	**68.428**	**(51.74)**	**71.293**	**(53.83)**	**78.474**	**(55.29)**
Common Controls								
5 year Treasury yield (-)	1.992	(2.05)	-1.698	(-0.87)	2.069	(2.07)	2.587	(1.55)
20 year-3 month Treasury yield (-)	**-7.487**	**(-9.88)**	**-4.663**	**(-3.39)**	**-7.323**	**(-9.64)**	**-6.126**	**(-4.71)**
30 day Eurodollar-Treasury (+)	**-11.959**	**(-6.84)**	**-0.907**	**(-0.55)**	**-12.154**	**(-6.91)**	**11.349**	**(5.86)**
Constant	**47.821**	**(7.50)**	**62.709**	**(5.52)**	**46.672**	**(7.16)**	**8.348**	**(0.82)**
Number of observations	254343		254343		254343		254343	
Pseudo R-squared	0.331		0.3445		0.3307		0.3136	

Panel B: Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Idiosyncratic variance	19.235	24.125	28.435	73.479
		25%	26%	24%	40%
2	Idiosyncratic variance	23.879	28.608	32.526	76.489
		31%	31%	28%	42%
	Idiosyncratic skewness	-10.772	-11.511	-10.994	-8.581
		-14%	-12%	-9%	-5%
3	Downside idiosyncratic variance	11.072	13.311	15.200	42.828
		14%	14%	13%	23%
	Upside idiosyncratic variance	7.011	9.711	11.619	27.908
		9%	11%	10%	15%
	Idiosyncratic value at risk	29.302	32.709	35.747	50.741
4		38%	35%	30%	28%

Table V: Results Using Both Systematic and Idiosyncratic Risks of Bonds

The tables below present the results of panel regressions of credit spreads on different systematic risk and idiosyncratic (bond-specific) risk measures and control variables. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors to vary over time. Panel A presents the parameter estimates for our risk factors averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor and its associated time dummies are all jointly equal to zero are presented next to each of our risk factor parameters in square parentheses. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A: Parameter estimates

Independent variable	(1)		(2)		(3)		(4)	
Systematic covariance (+)	**4.6544**	**[24.41]**	3.7347	**[29.49]**				
Systematic coskewness (-)			**-0.0485**	**[23.55]**				
Downside systematic variance (+)					**8.1824**	**[23.69]**		
Upside systematic variance (-)					**-2.5066**	**[14.73]**		
Systematic value at risk (+)							**-932.1422**	**[46.65]**
Idiosyncratic variance (1000s) (+)	**293.3205**	**[309.28]**	**453.87**	**[60.71]**				
Idiosyncratic skewness (-)			**2.3315**	**[44.42]**				
Downside idiosyncratic variance (1000s) (+)					**159.062**	**[146.51]**		
Upside idiosyncratic variance (1000s)(-)					**143.644**	**[74.37]**		
Bond idiosyncratic value at risk (+)							**-1454.4503**	**[546.8]**
Bond Specific Controls								
1/market value (+)	**2227.3**	**(7.22)**	**2311.4**	**(7.59)**	**2295.3**	**(7.53)**	**2201.681**	**(7.18)**
coupon rate (+)	**2.210**	**(5.05)**	**1.918**	**(4.43)**	**2.214**	**(5.06)**	**1.192**	**(2.50)**
time to maturity (+/-)	**0.224**	**(3.28)**	**0.151**	**(2.43)**	**0.230**	**(3.47)**	**0.918**	**(20.26)**
Dummy higher (-)	**-4.470**	**(-5.84)**	**-5.794**	**(-7.83)**	**-4.429**	**(-5.78)**	**-5.908**	**(-7.48)**
Dummy lower (+)	**22.607**	**(14.37)**	**21.993**	**(14.06)**	**23.234**	**(14.72)**	**26.438**	**(16.83)**
Dummy AA (+)	**5.393**	**(4.61)**	**2.529**	**(2.16)**	**4.624**	**(4.00)**	**5.289**	**(4.05)**
Dummy A (+)	**27.704**	**(19.44)**	**26.413**	**(18.98)**	**27.180**	**(19.72)**	**31.088**	**(21.28)**
Dummy BBB (+)	**70.052**	**(51.54)**	**67.091**	**(50.25)**	**69.597**	**(51.58)**	**77.135**	**(54.09)**
Common Controls								
5 year Treasury yield (-)	2.1628	(2.300)	-1.7091	(-0.870)	2.4581	(2.640)	5.8900	(3.850)
20 year-3 month Treasury yield (+)	**-7.1766**	**(-9.650)**	-1.3508	(-0.890)	**-7.3670**	**(-10.050)**	**-7.4702**	**(-5.320)**
30 day Eurodollar-Treasury (+)	**-12.4935**	**(-7.540)**	**-3.0952**	**(-2.000)**	**-12.7503**	**(-7.660)**	**12.4896**	**(6.980)**
Constant	**47.0300**	**(7.560)**	**52.4457**	**(4.520)**	**46.9358**	**(7.510)**	**-9.7129**	**(-1.020)**
Number of observations	254343		254343		254343		254343	
Pseudo R-squared	0.337		0.3564		0.3399		0.3249	

Panel B: Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Systematic covariance	2.234	3.247	3.647	5.940
		3%	4%	3%	3%
	Idiosyncratic variance	18.598	23.367	27.559	69.690
		24%	25%	23%	38%
2	Systematic covariance	3.311	4.586	4.962	6.845
		4%	5%	4%	4%
	Systematic coskewness	-0.025	0.939	0.292	0.897
		0%	1%	0%	0%
	Idiosyncratic variance	24.640	29.506	33.421	76.268
		32%	32%	28%	42%
	Idiosyncratic skewness	-7.632	-8.785	-8.294	-6.266
		-10%	-10%	-7%	-3%
3	Downside systematic variance	2.483	3.782	4.264	7.607
		3%	4%	4%	4%
	Downside Idiosyncratic variance	10.834	13.110	14.906	40.644
		14%	14%	13%	22%
	Upside systematic variance	-1.022	-0.226	-0.747	-1.886
		-1%	0%	-1%	-1%
	Upside bond specific variance	7.169	9.725	11.682	27.433
		9%	11%	10%	15%
4	Systematic value at risk	9.2401	7.5598	6.2824	7.3972
		12%	8%	5%	4%
	Idiosyncratic value at risk	40.637	45.52	49.34	68.695
		52%	49%	42%	38%

Panel C: Average weekly spread contribution in basis points and as a percentage of the average by rating spread of selected control variables

	AAA	AA	A	BBB
Coupon	8.235	8.551	8.561	9.140
	11%	9%	7%	5%
Time to maturity	16.737	13.386	11.711	14.524
	21%	15%	10%	8%
Size	7.487	8.525	8.855	9.080
	10%	9%	8%	5%

Table VI: Results Using Risks of Bonds and Equity Volatility

The tables below present the results of panel regressions of credit spreads on different systematic risk and idiosyncratic (specific) risk measures, control variables and with equity volatility. Equity volatility is measured as the standard deviation of the weekly return of the bond issuer in excess of the S&P 100 return over the previous 52 weeks. Estimates below are based on bond-week observations for which we are able to match the bond issuer with an equity issue. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors and equity volatility to vary over time. Panel A presents the parameter estimates for our risk factors and equity volatility averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor or equity volatility and its associated time dummies are all jointly equal to zero are presented next to each of our risk factor parameters in parentheses. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A: Parameter estimates

Independent variable	(1)		(2)		(3)		(4)		(5)	
Systematic covariance (+)			**-0.7872**	**[6.64]**	**-2.0023**	**[11.35]**				
Systematic coskewness (-)					**-0.1067**	**[16.81]**				
Downside systematic variance (+)							**5.6851**	**[4.85]**		
Upside systematic variance (-)							**-4.7338**	**[10.89]**		
Systematic value at risk (+)									**-1058.4086**	**[31.22]**
Idiosyncratic variance (1000s) (+)			**422.0203**	**[14.77]**	**436.1278**	**[80.31]**				
Idiosyncratic skewness (-)					**2.0912**	**[16.49]**				
Downside idiosyncratic variance (1000s) (+)							**240.5056**	**[55.32]**		
Upside idiosyncratic variance (1000s)(-)							**192.5018**	**[6.36]**		
Bond idiosyncratic value at risk (+)									**-1441.0501**	**[77.87]**
Stdeviation excess equity return (+)	**860.9969**	**[226.62]**	**507.0268**	**[23.31]**	**596.0945**	**[13.76]**	**509.6042**	**[24.26]**	**839.5613**	**[20.64]**
Bond Specific Controls										
1/market value (+)	**3544.7**	**(7.54)**	**2308.6**	**(4.97)**	**2238.934**	**(4.83)**	**2325.023**	**(5.09)**	**2522.098**	**(5.74)**
coupon rate (+)	**5.892**	**(9.59)**	**2.440**	**(4.28)**	**2.605**	**(4.47)**	**2.418**	**(4.26)**	**1.994**	(3.17)
time to maturity (+/-)	**1.333**	**(18.16)**	**0.445**	**(4.69)**	**0.357**	**(4.13)**	**0.455**	**(4.90)**	**0.982**	**(15.73)**
Dummy higher (-)	**-9.378**	**(-8.29)**	**-7.347**	**(-6.95)**	**-7.605**	**(-7.28)**	**-7.109**	**(-6.58)**	**-8.748**	**(-7.82)**
Dummy lower (+)	**32.824**	**(13.34)**	**22.937**	**(10.07)**	**22.474**	**(9.68)**	**22.796**	**(9.86)**	**26.327**	**(11.42)**
Dummy AA (+)	**9.475**	**(5.80)**	**7.128**	**(4.80)**	**7.254**	**(4.74)**	**6.634**	**(4.56)**	**8.809**	**(5.03)**
Dummy A (+)	**40.399**	**(20.88)**	**35.927**	**(18.27)**	**36.144**	**(18.67)**	**35.705**	**(18.79)**	**40.092**	**(19.96)**
Dummy BBB (+)	**82.108**	**(49.75)**	**68.983**	**(43.79)**	**68.010**	**(42.75)**	**69.270**	**(43.48)**	**76.254**	**(44.20)**
Common Controls										
5 year Treasury yield (-)	2.2674	(0.96)	2.0181	(0.990)	-2.4143	(-1.000)	3.1371	(1.440)	6.4284	(3.150)
20 year-3 month Treasury yield (+)	-12.2588	**(-6.33)**	-7.3661	**(-4.420)**	-1.9947	**(-1.000)**	-7.6655	**(-4.400)**	-11.5905	**-(5.750)**
30 day Eurodollar-Treasury (+)	8.2074	**(3.87)**	2.6640	(1.450)	0.3560	(0.190)	2.3347	(1.270)	15.5443	**(8.020)**
Constant	-16.4400	(-1.13)	6.9918	(0.540)	21.7419	(1.520)	2.9154	(0.210)	-49.4157	**-(3.890)**
Number of observations	149999		149999		149999		149999		149999	
Pseudo R-squared	0.240		0.289		0.3029		0.2945		0.2794	

Panel B: Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Standard deviation excess equity return	37.000	36.556	38.159	44.334
		47%	40%	32%	24%
2	Systematic covariance	1.463	2.084	1.952	1.613
		2%	2%	2%	1%
	Idiosyncratic variance	23.946	28.263	32.239	76.016
		31%	31%	27%	42%
	Standard deviation excess equity return	21.495	22.038	23.034	26.494
		28%	24%	20%	14%
3	Systematic covariance	2.449	3.256	3.142	2.155
		3%	4%	3%	1%
	Systematic coskewness	0.167	1.758	0.761	1.533
		0%	2%	1%	1%
	Idiosyncratic variance	24.185	28.877	32.748	75.588
		31%	31%	28%	41%
	Idiosyncratic skewness	-7.171	-8.732	-8.127	-5.864
		-9%	-9%	-7%	-3%
	Standard deviation excess equity return	22.113	21.115	22.109	26.139
		28%	23%	19%	14%
4	Downside systematic variance	1.662	2.568	2.828	4.910
		2%	3%	2%	3%
	Downside idiosyncratic variance	14.168	16.402	18.124	45.396
		18%	18%	15%	25%
	Upside systematic variance	-0.441	0.455	-0.584	-3.011
		-1%	0%	0%	-2%
	Upsideidiosyncratic variance	9.001	11.330	13.003	28.717
		12%	12%	11%	16%
	Standard deviation excess equity return	21.673	22.274	23.254	26.729
		28%	24%	20%	15%
5	Systematic value at risk	10.815	9.011	7.264	8.617
		14%	10%	6%	5%
	Idiosyncratic value at risk	41.305	45.852	49.313	68.215
		53%	50%	42%	37%
	Standard deviation excess equity return	30.770	30.084	31.516	37.441
		39%	33%	27%	20%

Table VII: Results Using Bond Value-at-Risk and Equity Value-at-Risk

The tables below present the results of panel regressions of credit spreads on equity and bond value-at-risk measures and control variables. Systematic equity value-at-risk is measured as the part of the largest negative excess return over the previous 52 weeks that can be explained by the crsp value weighted index return while the specific equity value-at-risk is the residual. Estimates below are based on bond-week observations for which we are able to match the bond issuer with an equity issue. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors and equity volatility to vary over time. Panel A presents the parameter estimates for our risk factors and equity volatility averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor or equity volatility and its associated time dummies are all jointly equal to zero are presented next to each of our risk factor parameters in parentheses. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A: Parameter estimates

Independent variable	(1)		(2)		(3)		(4)	
Systematic bond value at risk (+)					**-1071.6591**	**[46.00]**	**-1058.4086**	**[31.22]**
Specific bond value at risk (+)					**-1493.5293**	**[350.73]**	**-1441.0501**	**[77.87]**
Systematic equity value at risk (+)	**-349.7888**	**[23.85]**	**-322.7591**	**[13.95]**	**-365.3668**	**[10.30]**		
Specific equity value at risk (+)	**-100.3099**	**[164.28]**	**-2.4339**	**[10.16]**	**-119.1885**	**[3.88]**		
Stdeviation excess equity return (+)			**852.1924**	**[21.16]**			**839.5613**	**[20.64]**
Bond Specific Controls								
1/market value (+)	**3814.5**		**3486.3**		**2646.115**		**2522.098**	
coupon rate (+)	**5.495**		**5.887**		**1.738**		**1.994**	
time to maturity (+/-)	**1.384**		**1.360**		**1.045**		**0.982**	
Dummy higher (-)	**-12.065**		**-12.289**		**-11.148**		**-8.748**	
Dummy lower (+)	**35.562**		**32.810**		**28.442**		**26.327**	
Dummy AA (+)	**9.587**		**9.721**		**7.874**		**8.809**	
Dummy A (+)	**41.160**		**40.609**		**38.947**		**40.092**	
Dummy BBB (+)	**86.203**		**83.494**		**78.073**		**76.254**	
Common Controls								
5 year Treasury yield (-)	-3.56053		1.737125		2.633202		6.428369	
20 year-3 month Treasury yield (+)	-6.596062		-13.89579		-5.574777		-11.5905	
30 day Eurodollar-Treasury (+)	-0.5436092		8.145778		15.5609		15.5443	
Constant	20.09346		-13.59404		-29.99901		-49.41568	
Number of observations	149999		149999		149999		149999	
Pseudo R-squared	0.236		0.2487		0.2782		0.2794	

Panel B: Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Systematic equity value at risk	3.077	2.327	2.541	2.699
		4%	3%	2%	1%
	Idiosyncratic equity value at risk	6.872	4.882	7.860	11.495
		9%	5%	7%	6%
2	Systematic equity value at risk	3.065	1.905	2.360	2.483
		4%	2%	2%	1%
	Idiosyncratic equity value at risk	2.055	1.402	1.861	2.267
		3%	2%	2%	1%
	Standard deviation excess equity return	34.982	33.171	34.663	41.348
		45%	36%	29%	23%
3	Systematic equity value at risk	3.430	1.875	2.506	2.703
		4%	2%	2%	1%
	Idiosyncratic equity value at risk	6.935	4.703	7.194	9.800
		9%	5%	6%	5%
	Systematic bond value at risk	10.979	9.147	7.379	8.804
		14%	10%	6%	5%
	Idiosyncratic bond value at risk	42.216	47.095	50.696	69.709
		54%	51%	43%	38%
4	Systematic bond value at risk	10.815	9.011	7.264	8.617
		14%	10%	6%	5%
	Idiosyncratic bond value at risk	41.305	45.852	49.313	68.215
		53%	50%	42%	37%
	Standard deviation excess equity return	30.770	30.084	31.516	37.441
		39%	33%	27%	20%

Table VIII: Results for First Half and Second Half of Sample, Using Bond Risks

The tables below present the results of panel regressions of credit spreads on different systematic risk and specific risk measures and control variables. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors to vary over time. Panel A presents the parameter estimates for our risk factors averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor and its associated time dummies are all jointly equal to zero are presented next to each of our risk factor parameters in square parentheses. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A1: First Half

Independent variable	(1)		(2)		(3)		(4)	
Systematic covariance (+)	**4.0286**	**[58.59]**	**7.2461**	**[84.37]**				
Size risk (-)								
Book-to-market risk (+)								
Systematic coskewness (-)			**0.0044**	**[24.81]**				
Downside systematic variance (+)					**3.1957**	**[43.15]**		
Upside systematic variance (-)					**0.2179**	**[16.99]**		
Systematic value at risk (+)							**-670.7237**	**[81.8]**
Idiosyncratic variance (1000s) (+)	**251.8953**	**[1078.09]**	**468.5834**	**[146.34]**				
Idiosyncratic skewness (-)			**-0.9243**	**[176.07]**				
Downside idiosyncratic variance (1000s) (+)					**137.5381**	**[505.39]**		
Upside idiosyncratic variance (-)					**122.9869**	**[269.69]**		
Idiosyncratic value at risk (+)							**-1152.4730**	**[1881.52]**
Bond Specific Controls								
1/market value (+)	**2886.7**		**2923.4**		**2986.031**		**3182.785**	
coupon rate (+)	**0.172**		**-0.491**		**0.293**		**0.168**	
time to maturity (+/-)	**0.158**		**0.144**		**0.188**		**0.909**	
Dummy higher (-)	**-2.448**		**-3.886**		**-2.311**		**-3.100**	
Dummy lower (+)	**13.892**		**13.691**		**14.267**		**17.349**	
Dummy AA (+)	**9.056**		**8.218**		**8.609**		**11.315**	
Dummy A (+)	**28.296**		**27.432**		**28.238**		**33.368**	
Dummy BBB (+)	**66.186**		**63.400**		**66.341**		**73.482**	
Common Controls								
5 year Treasury yield (-)	-4.1364		2.8377		-3.9483		-2.9151	
20 year-3 month Treasury yield (-)	-9.6526		-0.2652		-10.6022		1.4583	
30 day Eurodollar-Treasury (+)	2.8449		3.1264		3.5623		8.6437	
Constant	85.2593		29.5499		84.5645		29.4571	
Number of observations	128119		128119		128119		128119	
Pseudo R-squared	0.641		0.667		0.6402		0.6102	

Panel B1: First Half- Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Systematic covariance	3.145	3.231	4.004	5.708
		4%	4%	3%	3%
	Idiosyncratic variance	17.394	23.554	26.395	50.164
		22%	26%	22%	27%
2	Systematic covariance	6.460	7.253	8.514	11.423
		8%	8%	7%	6%
	Systematic coskewness	0.280	-0.144	0.126	0.077
		0%	0%	0%	0%
	Idiosyncratic variance	27.604	34.378	37.244	65.210
		35%	37%	32%	36%
	Idiosyncratic skewness	0.498	-1.144	-0.914	-1.265
		1%	-1%	-1%	-1%
3	Downside systematic variance	2.500	2.629	2.959	4.379
		3%	3%	3%	2%
	Downside idiosyncratic variance	9.638	12.352	13.839	27.977
		12%	13%	12%	15%
	Upside systematic variance	-0.984	-0.268	-0.077	-0.080
		-1%	0%	0%	0%
	Upside idiosyncratic variance	7.119	10.648	11.547	20.789
		9%	12%	10%	11%
4	Systematic value at risk	4.528	3.857	4.304	4.754
		6%	4%	4%	3%
	Idiosyncratic value at risk	36.430	40.366	41.673	52.695
		47%	44%	35%	29%

Panel A2: Second Half

Independent variable	(1)		(2)		(3)		(4)	
Systematic covariance (+)	**4.2873**	**[17.57]**	**0.3362**	**[21.61]**				
Size risk (-)								
Book-to-market risk (+)								
Systematic coskewness (-)			**-0.0964**	**[23.93]**				
Downside systematic variance (+)					**12.0256**	**[17.7]**		
Upside systematic variance (-)					**-5.1095**	**[14.74]**		
Systematic value at risk (+)							**-1177.6573**	**[37.21]**
Idiosyncratic variance (1000s) (+)	**348.6069**	**[47.19]**	**456.9464**	**[24.45]**				
Idiosyncratic skewness (-)			**5.0832**	**[41.12]**				
Downside idiosyncratic variance (1000s) (+)					**188.8057**	**[83.82]**		
Upside idiosyncratic variance (-)					**167.8270**	**[41.14]**		
Idiosyncratic value at risk (+)							**-1763.9398**	**[274.51]**
Bond Specific Controls								
1/market value (+)	**1291.7**		**1437.0**		**1335.147**		**1002.918**	
coupon rate (+)	**4.302**		**4.319**		**4.240**		**2.444**	
time to maturity (+/-)	**0.319**		**0.158**		**0.308**		**0.934**	
Dummy higher (-)	**-8.132**		**-8.737**		**-8.191**		**-10.102**	
Dummy lower (+)	**29.742**		**28.816**		**30.498**		**33.621**	
Dummy AA (+)	**0.820**		**-2.962**		**-0.265**		**-0.305**	
Dummy A (+)	**25.819**		**24.618**		**24.874**		**27.937**	
Dummy BBB (+)	**72.432**		**69.760**		**71.445**		**79.457**	
Common Controls								
5 year Treasury yield (-)	8.6314		4.7844		9.1926		13.0033	
20 year-3 month Treasury yield (-)	-15.1533		-19.4692		-15.6913		-19.7608	
30 day Eurodollar-Treasury (+)	-39.3630		6.0331		-37.0139		12.6066	
Constant	48.6286		87.0702		49.7032		12.0016	
Number of observations	126224		126224		126224		126224	
Pseudo R-squared	0.246		0.2627		0.2501		0.2389	

Panel B2: Second Half: Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Systematic covariance	1.280	3.081	3.036	5.785
		2%	3%	3%	3%
	Idiosyncratic variance	21.234	24.714	30.318	89.299
		27%	27%	26%	49%
2	Systematic covariance	0.781	2.577	2.092	3.345
		1%	3%	2%	2%
	Systematic coskewness	-0.245	2.048	0.597	1.803
		0%	2%	1%	1%
	Idiosyncratic variance	23.359	26.557	31.609	87.770
		30%	29%	27%	48%
	Idiosyncratic skewness	-14.401	-15.255	-14.502	-10.524
		-18%	-17%	-12%	-6%
3	Downside systematic variance	2.131	4.419	4.874	9.769
		3%	5%	4%	5%
	Downside bond specific variance	12.538	14.488	16.632	53.594
		16%	16%	14%	29%
	Upside systematic variance	-1.164	0.053	-1.189	-3.410
		-1%	0%	-1%	-2%
	Upside idiosyncratic variance	8.006	9.484	12.518	33.755
		10%	10%	11%	18%
4	Systematic value at risk	13.916	11.492	8.539	10.300
		18%	12%	7%	6%
	Idiosyncratic value at risk	46.693	52.087	58.234	85.585
		60%	56%	49%	47%

Table IX: Results Using 26-Week and 104-Week Estimates of Bond Value-at-Risk

The tables below present the results of panel regressions of credit spreads on bond value-at-risk measures measured over 26 weeks (short horizon) and 104 weeks (long horizon) and control variables. The level (5 year constant maturity Treasury yield), slope of the term structure (gap between 20 year and three-month constant maturity Treasury yield) and the spread between 30-day Eurodollar and Treasury yields are used as common control variables while the market value of the bond issue (inverse), the coupon rate and bond time to maturity are used as bond specific control variables. Rating dummies to denote whether a bond is AA, A or BBB rated are also included. Two additional rating associated dummies are included: Dummy Higher is one in a given cross-section if a bond's rating one year ago was higher than its rating in the current week and Dummy Lower is one in a given cross-section if a bond's rating one year ago was lower than in the current cross-section. Results are based on ordinary least squares regression allowing the contribution to spreads of our risk factors to vary over time. Panel A presents the parameter estimates for our risk factors averaged over time and F-statistics from Wald tests under the null hypothesis that a given risk factor and its associated time dummies are all jointly equal to zero are presented next to each of our risk factor parameters in square parentheses. For other variables, Panel A presents parameter estimates and Newey-West corrected t-statistics in parentheses. Numbers in bold denote significance at the 0.1 per cent level. The weekly spread contribution of a given risk measure by rating is calculated by multiplying the average size of the risk measure across bonds by rating in that week by the parameter estimate corresponding to that risk measure in that week. Panel B presents the time series average contribution to spreads of each risk measure in basis points by rating.

Panel A: Parameter estimates

Independent variable	(1)	(2)
Systematic bond value at risk (26 weeks) (+)	-1064.148	
Idiosyncratic bond value at risk (26 weeks) (+)	-1203.654	
Systematic bond value at risk (104 weeks) (+)		-973.718
Idiosyncratic bond value at risk (104 weeks) (+)		-1303.509
Bond Specific Controls		
1/market value (+)	2256.934	3088.311
coupon rate (+)	1.801	3.893
time to maturity (+/-)	1.022	1.256
Dummy higher (-)	-5.456	-4.729
Dummy lower (+)	28.582	34.168
Dummy AA (+)	5.546	11.484
Dummy A (+)	31.871	36.103
Dummy BBB (+)	79.901	91.633
Common Controls		
5 year Treasury yield (-)	1.723	0.682
20 year-3 month Treasury yield (+)	-7.112	-12.126
30 day Eurodollar-Treasury (+)	8.467	-30.813
Constant	15.799	66.403
Number of observations	254343	204140
Pseudo R-squared	0.320	0.2189

Panel B: Average spread contribution in basis points and as a percentage of average by rating spread of risk factors

Equation	Independent Variables	AAA	AA	A	BBB
1	Systematic value at risk (26 weeks)	5.674	4.405	3.226	5.058
		7%	5%	3%	3%
	Idiosyncratic value at risk (26 weeks)	31.602	35.362	38.177	50.470
		41%	38%	32%	28%
2	Systematic value at risk (104 weeks)	6.599	5.131	3.888	5.010
		8%	6%	3%	3%
	Idiosyncratic value at risk (104 weeks)	33.902	37.656	40.597	53.776
		43%	41%	34%	29%