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Downside risk and the size of credit spreads

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ABSTRACT

We investigate why spreads on corporate bonds are so much larger than expected losses from default. Systematic factors make very little contribution to spreads, even if higher moments or downside effects are taken into account. Instead we find that sizes of spreads are strongly related to idiosyncratic-risk factors: not only to idiosyncratic equity volatility, but even more to idiosyncratic bond volatility and idiosyncratic bond value-at-risk. Idiosyncratic bond volatility helps to explain spreads because it reflects not just the distribution of firm value but is also a proxy for liquidity risk. Idiosyncratic bond value-at-risk adds to this by capturing the left-skewness of the firm-value distribution. We confirm our results both for the initial 1997–2004 sample period and also out of sample for 2005–2009, which includes the sub-prime crisis. Overall, credit spreads are large because they incorporate a large risk premium related to investors' fears of extreme losses.

1. Introduction

Many researchers have noted that spreads on corporate bonds are extremely large relative to their apparent risks. Spreads are larger than can be justified by expected losses from default (e.g. Elton et al., 2001) and larger than those generated by most option-based models which depend on the distribution of firm value (e.g. Eom et al., 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 short times to maturity.

The aim of our paper is to assess the extent to which measures of risk, derived from past equity and bond returns, can generate the credit spreads which are observed today. We use a sample of investment-grade corporate bonds observed weekly over 1998–2004 to answer this question and then confirm our results with an additional sample over 2005–2009, which includes the sub-prime crisis. Our focus is on explaining the sizes of spreads rather than just explaining their variances over time. In other words, we are more interested in economic relevance than in statistical significance, since in a sample as large as ours almost any variable is statistically significant but rather few are of economic importance.

We begin by examining the contribution of systematic risk and our first approach is the conventional one, which relates bond spreads to the three Fama/French systematic factors. Elton et al. (2001) suggest that these systematic risks – equity-market covariance, SMB and HML – may be important for bond spreads. These risks do explain some of the cross-sectional variance in our study, but their economic importance is minimal: together they generate just a few basis points of the median spread (of 111 basis points). Most studies to date have assumed that risk factors have a symmetric influence, but a few researchers have also suggested that spreads reflect the asymmetric returns which come from undiversifiable skewness in bond portfolios (Amato and Remolona, 2003, 2005). We therefore test whether higher moments – systematic co-skewness risk (Harvey and Siddique, 2000) or systematic downside covariance risk (Ang et al., 2006) – can explain observed spreads. Again we find that the effects are much too small to explain observed spreads. Consequently, we reach the conclusion that systematic risk factors, even with a downside focus, are weak candidates for directly explaining credit spreads.

Having dismissed systematic factors, we turn to the role of idiosyncratic factors in bond spreads. The theory of contingent claims (Merton, 1974) values a corporate bond as a risk-free bond less a deep-out-of-the-money put option on firm value. Based on this intuition, Campbell and Taksler (2003) show that idiosyncratic equity volatility (as a proxy for the volatility of firm value) has an important role in determining spreads. Extending this analysis,

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we examine two additional idiosyncratic bond return-based risk measures, namely idiosyncratic bond volatility and idiosyncratic bond value-at-risk. We find that both these risk measures contain additional information (beyond that in idiosyncratic equity volatility) that is relevant for determining credit spreads, and that idiosyncratic bond value-at-risk makes a larger economic contribution to spreads than does idiosyncratic bond volatility. Combining idiosyncratic value at risk with S&P volatility, we can explain up to 99 basis points (89%) of the median spread.

These results raise two questions. First, why does idiosyncratic bond volatility contain additional information to its equity counterpart in determining spreads? And second, why does idiosyncratic bond value-at-risk contain information not already captured by equity or bond volatility that is relevant to the size of spread? To answer the first question, we run regressions for data sorted into idiosyncratic-bond-volatility deciles and show that bonds with higher volatilities (and larger spreads) are also those which are more sensitive to changes in the level of liquidity. This suggests that bond volatility is a proxy for liquidity risk, with an impact large enough to generate a difference of 20 basis points in spreads between the top and bottom bond-volatility deciles.

We then address the second question, which concerns the information content of the idiosyncratic bond value-at-risk measure. Equity volatility and bond volatility are both proxies for the volatility of the risk-neutral distribution of firm value, whereas idiosyncratic bond value-at-risk captures not just the volatility of firm value but also its left-skewness. We would therefore like to know if the firm-value distribution is indeed left-skewed (in the risk-neutral domain), as that would be consistent with the importance of idiosyncratic bond value-at-risk to spreads. We test this conjecture in the following way. We take the estimated sensitivities of spreads to equity volatility for different levels of leverage (using deciles from our sample) and then use them to fit a structural model of the Merton type at each leverage level. (This approach to calibration circumvents the need to estimate firm volatility and does not appear to have been used before.) We demonstrate that the result from the data is an implied risk-neutral distribution for a representative firm which has a very fat left-hand tail. This is consistent with our hypothesis that idiosyncratic bond value-at-risk is able to generate realistic spreads because it takes into account the left-skewness of firm value in the risk-neutral domain.

While the paper was being finalized, the sub-prime crisis arrived and bond spreads increased hugely. We have therefore extended our original 1998–2004 sample to the period 2005–2009. This genuine out-of-sample test allows us to verify that bond volatility and bond value-at-risk remain important in determining spreads, both over the extremely quiet period of 2005–2006 and over the extremely turbulent period of 2007–2009.

The main contributions of our paper may be summarized as follows. First, we demonstrate that systematic risk has very little direct effect on the level of spreads, so the pricing of bonds cannot easily be related to the factors affecting the pricing of equities. Second, we show that idiosyncratic equity volatility has a larger impact on spreads, although not nearly as large as that found by Campbell and Taksler (2003). Third, we demonstrate that idiosyncratic bond volatility matters for spreads over and above the effect of idiosyncratic equity volatility, one reason being that it is a proxy for liquidity risk. Fourth, we find that idiosyncratic bond value-at-risk is the measure that generates the largest individual spreads, because it captures the long left-hand tail of the risk-neutral distribution of firm value. Fifth, we show that bond volatility and bond value-at-risk continue to be important determinants of spreads in the quiet period before the sub-prime crisis and in the turbulent period thereafter.

Our paper is related to several different strands in the existing literature. With respect to systematic risks, there has been surprisingly little work on whether conventional asset pricing models can explain either bond returns or bond spreads (notable exceptions being Fama and French (1993), Gebhardt et al. (2005), and Elton et al. (2001)) and we try to fill this gap. Collin-Dufresne et al. (2001) examine what determines changes in spreads rather than their size and conclude that there is a large unexplained component which is common across all bonds. Consistent with our paper, an implication of their research is that very little of the spread can be explained by the probability of default or by systematic factors.

Some researchers have investigated the extent to which liquidity could be the ‘missing factor’, but they are unable to explain more than about 20 basis points of the spread on investment-grade bonds (Ericsson and Renault, 2005; Perraudin and Taylor, 2003; Longstaff et al., 2005; Chen et al., 2007; Bongaerts et al., 2008a). Acharya and Pedersen (2005) have argued that attention in asset pricing should be directed not only at the liquidity level but also at liquidity risk. Using the extended CAPM model of Acharya and Pedersen, Bongaerts et al. (2008b) suggest that more than half (about 60 basis points) of the spread on AA-rated bonds may be due to liquidity risk but Acharya et al. (2008) find smaller values. This is not conclusive evidence because in these two studies liquidity is measured indirectly from Treasury bonds and equities. A recent paper by Dick-Nielsen et al. (2009) uses several different measures for liquidity level, together with the volatility of those measures as proxies for liquidity risk, to examine their potential contributions to spreads. They conclude that in normal times, such as before the sub-prime crisis (Q4/2004 to Q1/2007), liquidity level and risk could only account for 2–5 basis points of spread for investment-grade bonds, but that after the crisis in 2007, liquidity level and risk could account for a huge 64–116 basis points of spread.

The empirical paper which is closest to ours is by Campbell and Taksler (2003), who demonstrate that there is a strong positive relationship between idiosyncratic equity volatility and bond spreads. However, the spread/volatility relationship which they find is extraordinarily large, leading them to reject its consistency with structural models of the spread. Our view is that the structural approach to spreads is likely to be the correct one, even if the ‘perfect’ model remains unknown. This view is supported by Schaefer and Strebulaev (2008), who show that even a very simple Merton model is good for hedging of corporate bonds. Cremers et al. (2008) also show that contingent claims models can work. They construct a structural model with jumps that, when suitably calibrated, is capable of generating large credit spreads due to the presence of downside jump-risk premia. These downside jump-risk premia come through in our work in the form of the left-skewness in the risk-neutral distribution of firm value that we imply with our Merton-model calibration.[1]

Our paper is structured as follows. In Section 2 we describe the data, the risk variables and the control variables. Section 3 gives the results from testing systematic factors as generators of spreads. Section 4 analyzes the role of idiosyncratic risks in determining spreads and reveals empirically the importance of bond volatility and bond value-at-risk. Section 5 examines more precisely why bond volatility and bond value-at-risk are so important for the level of spreads. Section 6 extends the analysis to an out-of-sample period, 2005–2009. Finally, Section 7 draws together the conclusions and implications of our study.

[1] Two other factors that affect spreads according to recent papers are information uncertainty/asymmetry (Lu et al., 2010; Guentay and Hackbarth, 2010) and time-varying market sentiment (Tang and Yan, 2010).