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Understanding the term structure of credit default swap spreads ☆

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ABSTRACT

The shape of the term structure of credit default swap (CDS) spreads displays large variations over time and across firms. Consistent with the predictions of structural models of credit risk, we find that the slope of CDS spread term structure increases with firm leverage and volatility, but decreases with the level and the slope of the Treasury yield curve. However, these variables together have rather limited explanatory power for CDS slope and there is a significant common component in the regression residuals. In addition, we find that CDS slope predicts future changes in the CDS spreads, even after controlling for the contemporaneous variables that determine changes in the CDS spreads according to the structural models. Our results suggest that while structural models are qualitatively useful for understanding the shape of credit term structure, there are missing factors that importantly affect the term structure of CDS spreads.
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1. Introduction

The global financial crisis of 2008–2009 highlights the importance of understanding credit risk. Starting with Black and Scholes (1973) and Merton (1974), many structural models of credit risk which treat debts and equities as contingent claims on the firm's assets have been developed. Structural models are popular. Among other things, they provide a consistent framework to price debt, equity and credit derivatives.

This paper evaluates the usefulness of the structural models of credit risk using a comprehensive dataset on credit default swap (CDS), the most popular instrument in the rapidly growing credit derivative market.[2] A CDS is a swap contract in which the protection buyer makes a series of payments to the protection seller and, in exchange, receives a payoff in the case of credit events of the reference bond such as downgrading and default. The periodic payment, which is usually expressed as a percentage (in basis points) of the bond's notional value, is called the CDS premium, also commonly called CDS spread.[3]

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[2] According to BIS, the CDS market grew from $0.6 trillion in notional amount in 2001 to $62 trillion in 2007, but dropped to $26.5 trillion in July 2009.
[3] Duffee (1999) derives a theoretical arbitrage relation equating CDS premium to credit spreads, which are the difference in yield to maturity between a corporate bond and a U.S. Treasury bond with the same maturity. Blanco et al. (2005) find that while this parity relation holds on average over time, there are instances of deviations from parity relation.

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The CDS data we use have several important advantages over the corporate bonds data used in previous studies on credit risk. First, unlike corporate bond yield spreads, CDS spreads are not subject to the specification of benchmark risk-free yield curve and less contaminated by non-default risk components (Ericsson et al., 2006; Longstaff et al., 2005). Second, Blanco et al. (2005) show that there is a clear lead for CDS prices over credit spreads in the price discovery process. Third, compared to corporate bonds, credit default swaps have much simpler and uniform contractual characteristics. Thus, CDS provides a better setting to test the structural models.[4]

Under the structural models, credit spreads or CDS can be linked to macroeconomic and financial variables. One way to examine the usefulness of the structure models is to conduct regression analysis on the relationship between credit spreads or default swap spreads and key variables suggested by a structural model of credit risk. However, previous studies report mixed findings. Our study provides fresh evidence on the usefulness of the structure models through new lenses.

Using corporate bond data, Collin-Dufresne et al. (2001) conclude that the explanatory power of the theoretical variables motivated by the structural models is modest, and that a significant part of the residuals is driven by a common systematic factor which is not captured by the theoretical variables. They found that structural model variables explain less than 25% of the variation in credit-spread changes. On the other hand, Avramov et al. (2007) find that a set of common factors and company-level fundamentals inspired by structural models can explain more than 54% (67%) of the variation in credit-spread changes for medium-grade (low-grade) bonds. Cremers et al. (2008) find that essentially all systematic variation in credit spreads is captured by variables suggested by the structural models extended to allow for volatility and jump risk. They find no evidence of a large unidentified factor in the credit spread residuals.

Several studies using CDS data document very high explanatory power of structural model variables for the levels of default swap spreads. Ericsson et al. (2009) report regression R^2 of about 60% and only weak evidence of a residual common factor. Zhang et al. (2009) report that the volatility and jump variables can explain 53% of the variations in the CDS spreads. After controlling for credit ratings, macroeconomic conditions, and firms' balance sheet information, they can explain 73% of the total variation. Ericsson et al. (2009) and Zhang et al. (2009) focus on the five-year CDS spread, using the data from 1999–2002 and 2001–2003 respectively.

The rapid growth of the CDS market over the last decade enables us to study the usefulness of the structural models using the entire term structure of CDS, not just one particular maturity. We focus on the slope of the term structure of CDS spreads, defined as the difference between a five-year CDS spread and a one-year CDS spread. We study whether the structural models can explain the variations of CDS slope across firms and over time. A major advantage of using CDS data to study the credit term structure is that maturities of the CDS contracts are easily comparable across firms and fixed over time. In contrast, not all bonds have multiple maturities. Even if there are bonds of different maturities on the same firm, their contract terms may be different. The available bond maturity is not uniform across firms and varies a lot over time. Thus, previous studies that examine the shape of credit term structure using corporate bonds data usually first aggregate individual bonds into portfolios (e.g., sorted by rating and maturity). We study the shape of credit term structure at individual firm level.

We derive several implications of the general structural models concerning the determinants of slope of the term structure of the CDS spreads. For example, the CDS slope increases with firm leverage and volatility, but decreases with riskfree rate and the slope of the Treasury yield curve. We verify these predictions both numerically under several structural models such as the Leland (1994) model, and also empirically based on regression analysis of the CDS slope. Our results are robust to sample frequency and regression methodology. While the variables suggested by the structural models are related to the CDS slope with the predicted signs, together they explain no more than 36% of the variations in the CDS slope. We find evidence of a significant common factor in the regression residuals.

We also run panel regressions with CDS spreads or change in the CDS spreads (separately for the one-year and five-year contracts) as the dependent variables. The R^2 of the CDS level regressions is no more than 42%, and the R^2 for the change in the CDS level regressions is only about 1% to 10%. We find that even after controlling for determinants of changes in the CDS spreads suggested by the structural models, the lagged CDS slope remains an important predictor of changes in the CDS spreads. Taken together, our results indicate that while the structural models are useful qualitatively, they need to be extended to better capture the rich shape and variation of the term structure of credit risk as contained in the CDS data.

Our paper is related to a growing literature on the credit term structure. Duffie and Lando (2001) show theoretically that firms with more accounting transparency have flatter credit spread term structure. This prediction is supported by the empirical findings of Yu (2005) and Arora et al. (2011). Han et al. (2015) find that the slope of the CDS term structure is an important determinant of the cross-section of the expected stock return. Jarrow et al. (2010) examine the relative pricing of the credit risk of a company across maturities. Several studies debate about whether the average term structure of credit spreads is upward or downward sloping for non-investment grade bonds.[5] We are able to reconcile the mixed results in the existing literature using the CDS data.[6] In addition, we are the first to study the determinants of the variations in the slope of individual firms' term structure of CDS spreads.

[4] Ericsson et al. (2006) show that CDS and corporate bonds data can give different answers concerning the usefulness of the structural models. They find that several structural models tend to produce large pricing errors and underestimate bond spreads, especially for short maturity bonds. But the pricing errors for CDS spreads are a magnitude smaller, and some models actually overestimate CDS spread by a small amount.

[5] For example, Sarig and Warga (1989), Fons (1994) and Lando and Mortensen (2005) find a downward sloping credit term structure for non-investment grade bonds. On the other hand, Helwege and Turner as well as Huang and Zhang (2008) report and find that the term structure of credit spreads is usually upward sloping, even for low credit rating firms.

[6] Lando and Mortensen (2005) also study whether the average term structure of CDS spreads for various rating groups is upward or downward sloping. They do not study the determinants of the slope of individual firms' CDS term structure.

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