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ScienceDirect
Journal of Banking & Finance 32 (2008) 1269–1285
Journal of BANKING & FINANCE
www.elsevier.com/locate/jbf

The delivery option in credit default swaps ☆

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Received 30 October 2006; accepted 26 October 2007
Available online 4 December 2007

Abstract

Under standard assumptions the reduced-form credit risk model is not capable of accurately pricing the two fundamental credit risk instruments – bonds and credit default swaps (CDS) – *simultaneously*. Using a data set of euro-denominated corporate bonds and CDS our paper quantifies this mispricing by calibrating such a model to bond data, and subsequently using it to price CDS, resulting in model CDS spreads up to 50% lower on average than observed in the market. An extended model is presented which includes the delivery option implicit in CDS contracts emerging since a basket of bonds is deliverable in default. By using a constant recovery rate standard models assume equal recoveries for all bonds and hence zero value for the delivery option. Contradicting this common assumption, case studies of Chapter 11 filings presented in the paper show that corporate bonds do not necessarily trade at equal levels following default. Our extension models the implied expected recovery rate of the cheapest-to-deliver bond and, applied to data, largely eliminates the mispricing. Calibrated recovery values lie between 8% and 47% for different obligors, exhibiting strong variation among rating classes and industries. A cross-sectional analysis reveals that the implied recovery parameter depends on proxies for the delivery option, primarily the number of available bonds and bond pricing errors. No evidence is found for a direct influence of the bid-ask spread, notional amount, coupon, or rating used as proxies for bond market liquidity.

JEL classification: C13; G12; G13; G15

Keywords: Credit risk; Default; Corporate bond; Credit default swap; Reduced-form model; Recovery rate; Delivery option

1. Introduction

The pace at which the credit derivatives market has been growing since its inception about ten years ago topped all projections,[1] increasingly calling for the development of more and more accurate pricing tools for these products since market reality often reveals that assumptions underlying the prevalent models are inadequate and misleading.

The instrument this paper focuses on is a credit default swap (CDS). This is a bilateral contract aimed at transferring the credit risk of a (corporate or sovereign) borrower from one market participant (the protection buyer) to another (the protection seller). The CDS buyer pays a periodical premium for the assurance that the CDS seller will compensate him for the loss in case the borrower defaults during the term of the contract. If so, the protection seller pays the notional amount of the contract to the protection buyer as compensation for the loss incurred. The latter, in turn, must deliver obligations (usually bonds) of the defaulted borrower with total principal equal to the notional amount of the CDS contract.

☆ This paper was reviewed and accepted while Prof. Giorgio Szegö was the Managing Editor of The Journal of Banking and Finance and by the past Editorial Board.

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[1] The statement is based on a comparison of the figures projected in the BBA credit derivatives survey 2001/2002 and the latest market statistics provided, e.g. by ISDA market surveys for the global market at www.isda.org or by the OCC bank derivatives reports for the US market at www.occ.treas.gov.

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doi:10.1016/j.jbankfin.2007.10.012

Since the CDS is a derivative instrument based on defaultable debt as the underlying asset, it is natural to enquire about the relation between the prices of credit risk in the bond and derivatives markets charged for resp. to a particular borrower. Such a relation is of crucial importance for pricing and hedging credit exposures. Duffie (1999) shows that it is only under highly restrictive and simplifying assumptions that the intuitive equality holds between the premium on a CDS and the yield spread of a bond (written on resp. issued by the same corporate borrower) over its risk-free counterpart. In a static setting, taking merely no-arbitrage arguments into account, the equivalence is valid for par floating-rate notes rather than for par fixed-rate notes. As expected, applying this argument to observable CDS and bond yield spreads, pricing discrepancies are uncovered. The differences do not vanish even if one models the credit risk by employing standard pricing models instead of simply replicating cash flows. Not even complex credit risk models are presently able to price in the observed differences. In the market this differential between CDS and bond spreads (of equal maturities, usually five years) has become known as the *CDS basis*.

Literature hitherto still leaves open both the actual direction and the determinants of these pricing differences, as well as which explanatory approach should be taken. This paper explores the relation between the prices in the bond and derivatives markets on a representative and diverse cross-section of euro-denominated corporate bonds and CDS. Using standard assumptions we quantify mispricings when employing a deterministic reduced-form framework. In an extensive comparison of calibration properties in the bond market for several parameterizations of the default intensity the Nelson–Siegel specification turns out to be optimal. This parameterization is subsequently used to price CDS, resulting in model CDS spreads up to 50% lower on average than observed in the market – a finding qualitatively in line with Houweling and Vorst (2005).

To explain these mispricings, this paper studies the effect of the delivery option on the divergence in pricing between the bond and derivatives market: The form of settlement prevailing in the CDS market by far is physical delivery (in contrast to cash settlement), and a CDS contract commonly refers not to one single deliverable obligation only, but to a basket of deliverable obligations (cf. Section 3.1 for details). As illustrated by event studies in Section 3.2, contrary to the common presumption of equal bond prices in default, the differences between post-default prices of deliverable bonds cannot be ignored. One probable origin for differing bond prices in default – even within a single seniority class – is obvious: If the market expects the firm to avoid bankruptcy and continue operating following a default, bond prices will differ due to their coupon and maturity. Other possible origins include particular supply and demand situations in default, trading frictions and market imperfections (cf. Section 3.1 for details). We therefore include the recovery value of the cheapest-to-deliver bond in the model and extract it from CDS data as an indicator for the value of the delivery option. The new parameter considerably improves the pricing properties in the CDS market, as expected. The average implied recovery rates range from 8% to 47% and strongly vary across obligors and within individual ratings and industries.

Using regression analysis we explore the driving factors of these implied recovery rates. A cross-sectional regression reveals a statistically and economically significant dependence on delivery option proxies, which are the number of bonds outstanding, bond price ranges, and bond pricing errors. To test whether liquidity possesses direct explanatory power, the implied recovery rates are regressed against liquidity proxies such as the bid-ask spread, but these turn out insignificant. Our paper thus provides evidence that at least part of the documented differences in pricing between the bond and CDS market can be attributed to a direct effect of the delivery option. This result points out the necessity for incorporating the random nature of recovery rates into credit risk models to accurately price credit-risky instruments.

The line of research our work is embedded in are studies relying on the reduced-form model and its extensions. In Houweling and Vorst (2005), a reduced-form model with a polynomial intensity function and a fixed recovery rate is fitted to bond data and subsequently used to calculate model CDS spreads. The paper points out the differential pricing in the bond and derivatives markets by first directly comparing quoted CDS spreads to bond yield spreads and then to model CDS spreads. Their finding central to our paper is that bond spreads as well as model CDS spreads are lower compared to market CDS spreads. This mispricing is especially pronounced for speculative-grade borrowers, though not equally as clear-cut for investment-grade ones. Houweling and Vorst (2005) mention liquidity and the delivery option as possible causes for the different pricing in the two markets. These two factors, among others, have been discussed by several practitioners' reports as well, e.g. by Morgan Stanley (Hjort et al., 2002) and Lehman brothers (O'Kane and McAdie, 2001). To the best of our knowledge, due largely to their complexity there have only been very few attempts to include any of these factors in an actual valuation. The only explanatory approach taken up in the literature so far is liquidity.

In Jarrow (2001) liquidity risk is modeled in a reduced-form framework as a general convenience yield process affecting corporate bond prices. A subsequent empirical paper by Janosi et al. (2002) calibrates a concrete specification of this model to corporate bond prices adding an affine function of market variables as the convenience yield. Price fluctuations not captured by interest rate and credit risk processes turn out largely idiosyncratic. Modeling in a reduced-form framework as well, Longstaff et al. (2005) attach a liquidity discount process to cash flows from corporate bonds, but, arguing that CDS are the more liquid instrument, do not apply it to CDS spreads. They split the corporate bond spread into a default and a non-default