



CDOs and the financial crisis: Credit ratings and fair premia

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Abstract

We study risk and return characteristics of CDOs using the market standard models. We find that fair spreads on CDO tranches are much higher than fair spreads on similarly-rated corporate bonds. Our results imply that credit ratings are not sufficient for pricing, which is surprising given their central role in structured finance markets. This illustrates limitations of the rating methodologies that are solely based on real-world default probabilities or expected losses and do not capture risk premia. We also demonstrate that CDO tranches have large exposure to systematic risk and thus their ratings and prices are likely to decline substantially when credit conditions deteriorate.

Introduction

The spectacular growth of structured finance markets prior to the 2007–2009 financial crisis was only possible because CDO tranches offered a seemingly attractive combination of risk and return. A critical role was played by the rating agencies that certified most CDO tranches with investment grade ratings assuring investors about their safety. Moreover, CDO tranches offered higher yields relative to similarly-rated corporate bonds, which was very appealing to investors who assumed that ratings represent a universal and robust indication of default risks. However, such a rating-based approach failed completely in 2008 when the CDO markets collapsed and even some of the triple-A rated tranches lost 90% of their value and were downgraded to junk.

Most commentators of the financial crisis argue that credit ratings were inflated due to mistakes made by the rating agencies and point out to incentive problems in the ‘issuer pays’ business model. Moreover, investment banks are accused of having marketed and sold CDO tranches to (unwitting) investors at yields that were too low to compensate for their true riskiness. This might have been possible because many investors lacked the sophistication needed to independently assess CDO tranches and therefore

they relied heavily on ratings for risk management and pricing as discussed in the Financial Crisis Report (2010), and by Brennan et al., 2009, Crouhy et al., 2008, and Coval et al. (2009a).

There are several interesting questions to be addressed by the academic literature. What determines risk-return properties of CDO tranches? What is the meaning of credit ratings? Is creditworthiness of a triple-A CDO tranche similar to that of a triple-A corporate bond? Can corporate bond yields be used as benchmarks for pricing similarly-rated CDO tranches? Is the downfall of CDO tranches a result of ex-ante incorrect credit ratings and mispricing of these securities prior to the financial crisis?

We take a theoretical approach to address these questions. We use the market standard models for rating and pricing CDO tranches to evaluate several stylized CDOs. The market standard rating model is in principle very similar to the market standard pricing model as they both rely on the Gaussian copula to capture default dependence. The crucial difference is that the rating model calculates tranche losses implied by historical default probabilities (*PDs*) of the collateral bonds, whereas the pricing model uses risk-neutral probabilities. As a stylized example, we consider a portfolio of a typical hundred 'BBB-' bonds, which are securitized to create a CDO with five tranches, one of which is also rated 'BBB-'.

The main result of this paper is that fair spreads on CDO tranches are much higher than fair spreads on similarly-rated corporate bonds. In other words, CDO tranches offer substantial *yield enhancement* relative to bonds. In our stylized example, a CDO tranche rated 'BBB-' has a fair spread almost three times higher compared to a 'BBB-' bond. Even more striking, an equally-rated CDO-squared tranche has a fair spread roughly seven times higher than the bond. This illustrates that credit ratings are by far insufficient for pricing CDO tranches. It can be explained by the fact that credit ratings reflect real-world (historical) default probabilities or expected losses (*ELs*), while fair spreads reflect not only such pure default risk but also risk premia (i.e. risk-neutral expected losses). This is also the case in corporate bond markets, but we show that for CDO tranches the divergence between real-world and risk-neutral expected losses is typically multiple times larger than for corporate bonds.

We also investigate risk properties of CDO tranches. We show that expected losses on CDO tranches are highly sensitive to changes in *PDs* of the underlying bonds. This feature is critical for understanding CDOs because it explains how tranches can have relatively low real-world expected losses (i.e. qualify for investment grade ratings) and much higher risk-neutral expected losses (i.e. offer attractive spreads). However, this feature also implies that ratings and prices of CDO tranches have low stability. In particular, CDO tranches are likely to perform poorly whenever the economy enters a recession. In such a case, market participants revise upward their estimates of collateral bonds' *PDs* and also demand higher risk premia. Due to the aforementioned sensitivity of tranches, this will have a much stronger effect on ratings and prices of CDO tranches than on corporate bonds. We also discuss the interplay between changes in ratings and prices and we explain why structured finance markets are prone to experiencing large boom and bust cycles.

Our results demonstrate that the current rating system can be gamed if it is used for pricing purposes because fair spreads on CDO tranches can be multiple times larger compared to similarly-rated bonds. Excess spreads on CDO tranches constitute possible gains from rating arbitrage, which explains why the structured finance industry was so profitable. On the one hand, originators of CDOs can retain part of the excess spreads as compensation for risks and efforts associated with originating CDOs. On the other hand, investors can boost their returns on highly rated assets. A similar point is made by Brennan et al. (2009) who use an analytical approach based on the CAPM and the Merton model to analyze possible gains from rating arbitrage.

This paper makes several contributions to the existing literature. Coval et al. (2009a) argue that market yields on CDX tranches before the crisis were too low because investors relied on credit ratings for pricing, while Collin-Dufresne et al. (2012) use the same data to show that CDX index tranches were actually priced correctly if the model incorporates more dynamic features. These studies price CDX tranches relative to the S&P option markets, which provides insights into integration between these two correlation markets. We show that a typical CDO tranche has a much higher fair spread than a similarly-rated bond when priced according to the market standard models.

Our results also provide new insights about distinguishing risk-return properties of CDO tranches. The existing literature uses the market standard models to show that credit ratings of CDO tranches are highly sensitive to assumed parameters, see Coval et al., 2009b, Hull and White, 2010. We provide a broader view, which incorporates both rating and pricing of CDO tranches. We show that the risk profiles of CDO tranches that result in fragility of ratings at the same time imply that CDO tranches have much higher fair spreads. We thus demonstrate that the market standard approach is able to capture the trade-off between risks and returns of CDO tranches. Another novelty of the paper is that we consider the incentives of CDO originators and the criteria of the rating agencies, and we show that a recipe for maximizing yield enhancement on tranches is to produce CDOs backed by highly diversified portfolios of bonds with high CDS spreads relative to their credit ratings. We also use the standard models to make inference about (low) stability of ratings and prices of CDO tranches that is consistent with market developments during the financial crisis.

In the discussion about the meaning of credit ratings and their performance during the crisis, it is often argued that credit ratings were incorrect as a result of overly optimistic rating assumptions (e.g. too low correlations) and limitations of the rating models (such as failure to account for parameter uncertainty or reliance on the Gaussian copula), see, among others, Fender et al., 2008, Coval et al., 2009b, Griffin and Tang, 2011, Hull and White, 2010, Mason and Rosner, 2007. However, we argue that even if credit ratings represented accurate and unbiased estimates of real-world default probabilities and expected losses, then fair spreads and risks of CDO tranches would still be much higher compared to similarly-rated bonds. Such interpretation follows from our approach to analyze the risks and returns of CDO tranches in a stylized environment where model parameters are assumed to be known and equal to the parameters of the true default process. This means that we assume away model misspecification. Of course any mistakes made by the rating agencies in estimating various parameters as well as possible inaccuracy of the market standard models are additional factors further limiting the reliability of credit ratings.

Related literature on structured finance also includes Longstaff and Rajan (2008) who examine pricing of CDO index tranches as well as Stanton and Wallace (2011) who study pricing of ABX tranches. Franke et al., 2012, Benmelech and Dlugosz, 2009a examine properties of CDO transactions and their implications, while Krahnert and Wilde (2008) focuses on risk transfers associated with CDOs. The performance of CDO ratings during the crisis is studied by Benmelech and Dlugosz, 2009b, Cordell et al., 2011. A growing number of papers examine incentive problems within the rating industry, see Bolton et al., 2012, Bar-Isaac and Shapiro, 2012, Griffin and Tang, 2011.

The rest of the paper is organized as follows. Section 2 discusses the background of the structured finance markets. Section 3 explains the modeling approach, while Section 4 discusses our assumptions and defines the stylized CDOs. In Section 5 we present our findings on the CDO yield enhancement and in Section 6 we analyze the sensitivity of tranche payoffs. In Section 7 we examine the stability of ratings and prices of CDO tranches, while in Section 8 we discuss regulatory implications. Section 9 concludes.

Section snippets

Background

Structured finance transforms corporate bonds and other assets into securitized tranches characterized by different risk-return properties. A CDO is created by pooling underlying securities into a well-diversified collateral portfolio and allocating the cash flows from this portfolio between the CDO tranches in a prioritized manner. Most of the credit risk is thus concentrated in the first-loss equity tranche, which also provides the highest coupon. More senior tranches have lower default risks ...

Model

In this section, we provide an overview of the market standard methods for rating and pricing CDO tranches. A more detailed description is given by Mounfield, 2009, S&P, 2005.

Let a CDO collateral pool consist of $i = 1, \dots, n$ (synthetic) bonds with each bond i having a notional N_i . The CDO's maturity time is T . Default times of the obligors are denoted by $\tau_1, \tau_2, \dots, \tau_n$ and the recovery rates are denoted by R_i . The cumulative losses on the collateral pool up to time t are given by:

$$L(t) = \sum_{i=1}^n N_i (1 - R_i) \mathbf{1}_{\tau_i < t \dots}$$

Manufacturing CDO tranches

Manufacturing structured assets consists of two steps. The first step is to select the collateral portfolio. The second step is to choose the optimal capital structure (*tranching*) for a given collateral portfolio. For convenience, we start by discussing the second step.

The CDO originators aim to capture the difference between coupons received on the collateral bonds and coupons paid out on the tranches. They have therefore incentives to produce tranches with as high ratings as possible as they...

Credit ratings and fair premia

In this part, we investigate the relation between credit ratings and fair premia. The results of structuring and rating of the CDO tranches as described in the previous section are reported in columns (1) and (2) of Table 1. In addition, columns (3)–(5) report tranche default probabilities, expected losses and spreads calculated under the physical measure corresponding to collateral bonds' PDs of 10% over a 10-year horizon. We can see how CDO prioritization of cash flows determines the risks of ...

Sensitivity analysis

In this section we examine the sensitivity of tranche payoffs to default probabilities of the underlying bonds with the aim of providing a clear-cut explanation of the yield enhancement on tranches and illustrating their associated risk properties. We depict sensitivity of default probabilities and expected

losses of CDO tranches because they determine credit ratings and, moreover, expected losses under the risk-neutral measure are closely related to fair spreads....

Rating and price stability of CDO tranches

Fig. 1, Fig. 2 of the previous section show that even a highly rated tranche, which is structured to have a minute expected loss under the physical measure, can incur heavy losses if the realized default rate of the collateral pool exceeds the assumed threshold. In a dynamic setting, tranche prices are likely to become depressed even prior to the realization of actual collateral losses. When credit conditions deteriorate, CDS spreads widen as a consequence of a rise in actual default...

Regulatory implications

The results presented in this paper have several regulatory implications. The limitations of credit ratings discussed in the previous sections call into question the use of rating-based restrictions for regulating risk-taking of institutional investors. Such restrictions do not allow investors to hold portfolios of lower rated corporate bonds, while leaving highly rated CDO tranches as an alternative to boost returns at the cost of higher exposure to systematic risk. A possible solution is to...

Conclusions

We demonstrate that CDO tranches have much higher fair spreads than similarly-rated corporate bonds. Moreover, fair spreads on CDO tranches are highly dependent on collateral portfolio characteristics, which means that the rating criteria can be gamed. Our results illustrate limitations of credit ratings that are based solely on real-world payoff prospects. While CDO tranches are tailored to have sufficiently low real-world default probabilities and expected losses to qualify for the highest...

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