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The impact of liquidity on senior credit index spreads during the subprime crisis☆,☆☆

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ABSTRACT

This paper examines the effects of liquidity during the 2007–09 crisis, focussing on the Senior Tranche of the CDX.NA.IG Index and on Moody's AAA Corporate Bond Index. It aims to understand whether the sharp increase in the credit spreads of these AAA-rated credit indices can be explained by worse credit fundamentals alone or whether it also reflects a lack of depth in the relevant markets, the scarcity of risk-capital, and the liquidity preference exhibited by investors. Using cointegration analysis and error correction models, the paper shows that during the crisis lower market and funding liquidity are important drivers of the increase in the credit spread of the AAA-rated structured product, whilst they are less significant in explaining credit spread changes for a portfolio of unstructured credit instruments. Looking at the experience of the subprime crisis, the study shows that when the conditions under which securitisation can work properly (liquidity, transparency and tradability) suddenly disappear, investors are left highly exposed to systemic risk.

1. Introduction

Before the subprime crisis started, the trading volume of credit derivatives had grown at a very fast pace from less than US$1 trillion in 1997 to around US$26 trillion in 2007.[1] Structured products with complex payoffs, such as collateralized debt obligations (CDOs), were created using the securitisation technology (pooling and tranching claims with different risk exposures) and were sold in the market. In 2003, CDOs represented 20% of the total credit derivatives market. However, in 2008 this figure decreased drastically to less than 5%. In the second half of 2007, disruptions started in the U.S. subprime mortgage market and then spread to other apparently unrelated markets, causing a sudden "drying up" of liquidity and an increase in the premia of all structured finance products (CDOs), including the top-rated (AAA) ones.[2] A widespread view is that the dysfunctionality of these top-rated structured products during the financial crisis of 2007–09 was caused by *market* and *funding* liquidity frictions. In this paper we explore this view by focussing on the Senior Tranche of the Credit Default Swap Index for North American investment-grade corporate bonds (ST CDX.NA.IG) in the period that runs from September 2006 to May 2009.[3] Moreover, we also examine the credit spread of Moody's AAA Corporate Bond Index in order to detect whether market and funding liquidity frictions have had the same or different effects on *senior structured* versus *senior unstructured* credit indices. Although both ST CDX and AAA Bond Index are senior products with AAA ratings, there is a major difference between them. The 125 firms which compose the CDX.NA.IG Index are mostly A or BBB rated. However, due to the tranching process, the Senior Tranche of the CDX.NA.IG Index bears the losses from the underlying pool of credit default swaps (CDSs) only after the principal of all the subordinated tranches has been exhausted. This prioritization rule allows the ST CDX to have very low default probability and a AAA rating, at least in normal times. The AAA Bond Index is formed instead

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[1] British Bankers Association data. For further detailed statistics, see Choudhry (2010) at pages 58–69.

[2] The rise and fall of the CDO market has boosted the development of theoretical models for pricing of these instruments (see for discussion Collin-Dufresne, 2009).

[3] For a detailed explanation of the time sample selection, see Section 2.2.1.

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by bonds issued by actual AAA-rated firms. It is interesting therefore to examine empirically the determinants of the credit spreads of the two indices and explore how they were affected by the financial crisis (characterised by a loss of liquidity, transparency and tradability in the relative markets).

The post-crisis literature about the pricing of CDOs and CDX tranches is mainly concentrated in the papers of Coval, Jurek, and Stafford (2009) and Collin-Dufresne, Goldstein, and Yang (2012). Coval et al. (2009) claim that before the subprime crisis the observed spread on Senior Tranches of the CDX Index was too low, so its dramatic increase during the crisis can be explained as a correction of a pre-existent mispricing. In other words, before the crisis investors relied too much on credit ratings and ST CDX writers insured "economic catastrophe bonds" without appreciating their large exposure to systemic risk and without demanding an adequate compensation for bearing this risk. Collin-Dufresne et al. (2012) note that these conclusions cannot be reconciled with the sophistication of traders in CDX (and CDO) markets, who would not be willing to bear so much risk without a proper evaluation and a fair compensation. Calibrating a more complex structural model to match the entire term structure of CDX index spreads (rather than only the five-year spreads), they show that the CDX tranches were on average fairly priced both before and during the financial crisis. Thus, they reject the hypothesis of a large pre-crisis mispricing of CDX Senior Tranches. Although the predictions of Collin-Dufresne et al. (2012) display some improvement over the predictions of Coval et al. (2009), the structural model they use can price the Senior Tranche 15–30% CDX spread fairly well over the crisis period only by setting a crash-risk parameter to the worst possible scenario. One aspect that has been omitted in the analysis by both Coval et al. (2009) and Collin-Dufresne et al. (2012) is the study of the time variation in the non-default components of the Senior Tranche CDX spread, particularly in its liquidity premium component.

The liquidity factor is a potentially important determinant of both structured and unstructured credit spreads. A study of its time-varying impact on credit spreads can help to shed some light on the pricing of the ST CDX and AAA Bond Index. The existing literature explains how market liquidity can affect a portfolio of credit spreads. In particular, Longstaff (1995) and Ericsson and Renault (2006) develop models of liquidity premia in corporate bond markets based on imperfect marketability: more illiquid bonds carry larger yields as compensation for investors who hold them. Bongaerts, de Jong, and Driessen (2011) develop a pricing model for credit derivatives and explain that the liquidity premia in CDS and CDX arise as a result of the heterogeneity between buyers and sellers of CDS protection. Some previous empirical research has detected significant liquidity components in corporate bond spreads (Chen, Lesmond, & Wei, 2007; Dick-Nielsen, Feldhütter, & Lando, 2012; Huang & Huang, 2012; Longstaff, Mithal, & Neis, 2005) and in single-name CDSs (Chen, Cheng, & Wu, 2013; Chen, Fabozzi, & Sverdlove, 2010; Leland, 2008; Tang & Yan, 2007).

In addition, the lack of funding liquidity can affect aggregate credit spreads via two channels. First, it can cause higher costs for firms to obtain short-term funds. This issue can prevent firms from operating regularly; it can increase their likelihood of default and widen their credit spreads. A clustering of firms' defaults can cause the spread of the Senior Tranche of the CDX Index to widen. Second, an increase in short-term funding costs has a negative impact on traders in credit markets. The models by Brunnermeier and Pedersen (2009) and He and Krishnamurthy (2012), among others, show that when funding liquidity is extremely scarce, traders may not be able to take or maintain their positions in bonds and tranches of CDS indexes. The tightening of funding liquidity may induce fire-sales of securities and exacerbate the loss of market liquidity; in turn, the evaporation of market liquidity may worsen the funding shortage.[4]

The empirical literature on CDX tranche pricing has not yet explored the effect of market and funding liquidity frictions during the financial crisis of 2007–09. Fabozzi, Wang, Yeh, and Chen (2009) examine the spreads of the CDX.NA.IG index tranches over the limited pre-crisis sample of 2003–05 and find that liquidity (proxied by the firms' total market capitalisation) has no power to explain changes in the Senior Tranche spread. Alexander and Kaeck (2008) examine iTraxx Europe spread changes over the pre-crisis period using Markov-switching regressions. They notice that the implied volatility of equity index options becomes a major determinant of changes in CDS index spreads during more turbulent times, whilst equity index returns have a predominant role in more stable periods. Scheicher (2008) examines the determinants of the daily price movements in CDX index tranches (North America CDX and European iTraxx). Using simple regression analysis on variables in first differences, he finds that during the financial crisis the credit-tranche premia are influenced by a large unobservable component (different from the credit fundamentals suggested by a structural model). Our paper attempts to fill this gap in the literature: it focuses on the Senior Tranche (15–30%) of the CDX.NA.IG Index and aims to detect the contribution of market and funding liquidity to the increase in the tranche spread.[5]

In order to study the effects of liquidity on the senior credit indices we need to disentangle them from the effects of changes in credit risk fundamentals and investor sentiment.[6] We base the empirical analysis of credit risk fundamentals on the inputs of the structural model first introduced by Merton (1974). The model establishes that the main *observable* determinants of the firm's default probability (and credit spread) are the firm's equity value and volatility, the firm's leverage, and the term structure of risk-free interest rates. In addition, since we study a portfolio (or index) of credit spreads, we need to take into account the probability of clustered defaults among all firms' constituents. Practitioners and academics often refer to the slope of the implied volatility curve for equity index options (plotted against options' moneyness) as an indicator of investors' appraisal of the likelihood of market-wide crashes and clustered defaults. Therefore, in our analysis we include also this key variable. To conduct the analysis of the dynamics of credit index spreads, we use cointegration and error correction models (ECMs). The cointegration analysis detects an arbitrage equilibrium between credit spreads and those *state fundamental* variables (equity index returns and volatility, the equity index option implied volatility skew, and the level and slope of the term structure of interest rates) that the theory of structural models suggests to be closely related to credit spreads. Daily movements in the credit spreads are then examined through ECMs where, in addition to these state variables, changes in liquidity are also used as explanatory variables for changes in ST CDX and AAA Bond Index credit spreads. Cointegration and ECM analysis are performed using daily data.

We find that the signs predicted by the theory for the relationship between credit spreads and state fundamental variables are all confirmed for both senior credit indices. However, whilst liquidity is found to be a main driver of the increase in the spread of the Senior Tranche CDX Index during the crisis period, it appears insignificant during the more stable pre-crisis period. Furthermore, although liquidity has much higher explanatory power during the crisis than before for the AAA Bond Index spread also, the liquidity variables are not statistically significant when used in the ECM regressions. These findings

[4] Sometimes, it is market liquidity that evaporates first. For instance, in the summer of 2007, the inability to value and trade complex structured credit products caused a run on off-balance sheet vehicles (conduits and Special Investment Vehicles — SIVs) where the products were located, as investors refused to renew the asset-backed commercial paper that financed them (Borio, 2010).

[5] In our work, funding liquidity is proxied by the one-month commercial paper spread (over the one-month Treasury-Bill yield), while market liquidity is proxied by the Senior Tranche CDX bid–ask spread. A higher bid–ask spread on ST CDX means higher transaction costs associated with this market. A higher commercial paper spread means higher costs for firms to obtain short-term funds.

[6] In this work "sentiment" is defined as a measure of the relative pessimism/optimism of investors with respect to future movements in the equity market and it is proxied by the equity put–call volume ratio provided by the Chicago Board Options Exchange (CBOE) and by the difference between the VXO implied volatility index and the historical S&P 100 volatility. For discussion on non-default variables, see Section 2.2.3.