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Debt correlations in the wake of the financial crisis: What are appropriate default correlations for structured products?☆

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ABSTRACT

This paper proposes several frameworks to estimate the appropriate default correlations for structured products, each of which jointly considers the role of co-movements in modeled risk characteristics and unmodeled systematic risk, or ‘frailty.’ We contrast our estimates with credit rating agencies’ default correlation assumptions, which were only 0.01 for Collateralized Loan Obligations (CLOs) pre-crisis and have increased to 0.03 post-crisis. In contrast, the joint consideration of observable risk factors and frailty leads to substantially higher estimates of 0.12. We show that this translates into CLOs with credit risk understated by 26%, suggesting caution for the post-crisis structured finance market.

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1. Introduction

During the financial crisis, over 13,250 AAA-rated tranches with an issuance value of \$1.26 trillion conse-

quently defaulted on their claims.¹ A commonly perceived force of this activity is that actors did not understand the highly correlated nature of Mortgage Backed Securities (MBS), Collateralized Debt Obligations (CDO), and other structured finance collateral’s default risk. A *Financial Times* article concisely summarizes: “Simply stated, what was supposed to be correlated in a certain way turned out to be correlated in a completely different fashion.”² Federal Reserve Chairman Ben Bernanke told the Financial Crisis Inquiry Committee, “They did not take into account the appropriate correlation between [and] across the categories of mortgages.”³ Despite the level of attention paid to default correlations, the discussion remains qualitative in nature. No work has quantified what exact default

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¹ Our calculation is based on data pulled from Bloomberg on the universe of 2,350 structured products issued between January 2000 and December 2007 that defaulted between January 2008 and May 2014.

² Pablo Triana, July 26, 2010, *Financial Times*.

³ Financial Crisis Inquiry Commission (2010, p.149)

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correlations were assumed by rating agencies prior to 2007 and to what extent these estimates have been updated in the wake of the financial crisis—an important question given the revival of the structured finance market with over \$3.10 trillion in securities issuance between January 2010 and June 2015.⁴

Our first objective is to obtain a sense of what pre-crisis correlations were. To examine this question, we back out default correlation estimates from pre-crisis rating agency data. We build several intuitive methodologies to derive default correlation estimates across a set of modeling frameworks. We then compare these estimates to those used by rating agencies for what industry sometimes refers to as ‘2.0’ (or post-crisis) structured products.

The infrequent nature of default events makes it difficult to model their underlying correlated nature. Additionally, an important unmodeled or omitted variable can emerge and cause a wave of defaults at a particular point in time. Taleb (2007) popularized one narrative of this concept known as the ‘black swan event’ where previously unforeseen events cause chaos on bank risk models and lead to a crisis. More importantly, Duffie, Eckner, Horel and Saita (2009) propose a method to capture the tail loss risk associated with an unmodeled systematic risk factor. Even after controlling for a broad spectrum of firm-specific and macro-explanatory variables, they find that an unobservable time-varying factor referred to as ‘frailty’ can significantly help in explaining default clustering. They discuss the potential importance of frailty for portfolios of assets, such as those found in a CDO, but they do not show how it can be incorporated into default correlations, nor compare this to estimates currently used in practice. Our paper is the first to detail an approach to incorporate the effects of both frailty as well as the co-movement of observable risk characteristics into an estimate of default correlations. We document the default correlations assumed by the rating agencies, contrast their assumption with our estimates, and quantify the effects of our frailty-incorporated default correlation estimates on the appropriate size of actual senior AAA-rated CDO tranches.

The traditional theoretical literature focuses on the correlation in default intensities of assets.⁵ In contrast, our study examines the correlation in the realization of defaults between assets. While the modeling of correlations among default intensities has clean mathematical properties, it is conceptually difficult to map such default intensity correlations to actual defaults. Ultimately, the credit-worthiness of a structured finance product is dictated by the realized defaults of its underlying collateral pool. For this reason, practitioners primarily focus on the correlation of realized defaults. Credit rating agencies specifically mention a concern for achieving the appropriate correlation of realized defaults (Moody’s, 2010) and base their fi-

nal metrics of both collateral correlation and collateral risk on the distribution of realized asset defaults (Standard & Poor’s, 2013). Thus, by estimating default correlations from realized defaults, we are able to directly compare the operating assumptions of rating agencies to estimates of joint collateral risk under our framework.

As a benchmark for common practice, we begin by asking what correlation levels were assumed by rating agencies for structured finance products leading up to the financial crisis. We back out default correlations from rating agency data and find that Standard and Poor’s (S&P) and Moody’s assumed an average default correlation from 1997 to 2007 of 0.01. To provide some economic context for the relevance of default correlations for CDOs, we show that a change in default correlation from 0.005 to 0.035 leads to approximately a 10% increase in the proportion of subordinated tranches needed to protect the claim of a senior AAA tranche.

Given the importance of default correlations, we use multiple distinct methodologies, each of which is based on systematic changes in both observable and unobservable risk factors, to estimate their appropriate level. The first class of models we consider is based on clustering in credit rating upgrades and downgrades using different characterizations of a state-dependent rating transition matrix. Ashcraft, Goldsmith-Pinkham and Vickery (2010) show that there is variation in performance beyond initial credit ratings based on other observable risk characteristics. In a similar manner, we also consider a second class of models which evaluates the importance of a panel of macroeconomic variables in explaining default risk. For each model, we then incorporate unobservable systematic changes in default risk, or ‘frailty,’ utilizing the framework of Duffie, Eckner, Horel and Saita (2009). With these tools, we are able to estimate default correlations for CDOs backed by corporate debt. In addition, by considering multiple models we are able to evaluate the sensitivity of our default correlation estimates to the choice of modeling assumptions.

For corporate bonds before the financial crisis (1986 to 2006), our estimated pairwise default correlation is only 0.002 when using only the state-dependent rating transition matrix. However, when allowing only for model frailty, the average pairwise bond default correlation jumps to 0.086. These default correlations are more than eight times those used by rating agencies for CLOs prior to the crisis. Furthermore, the inclusion of both rating changes and model frailty increases the average default correlation to 0.10. This estimate increases by roughly 25% to 0.125 when incorporating information contained in the financial crisis and estimating the models using a sample ending in December 2012. Overall, our findings show that the joint consideration of co-movement in observable risk factors and frailty can add considerable thickness to the right tail of the default distribution.

We now turn our attention to the extent to which rating agencies incorporated information gained from the financial crisis by examining a set of post-financial crisis CLOs. Using a small sample of 136 CLOs rated by S&P, we find that the average default correlation assumed by rating agencies has increased to 0.033 (as compared to 0.01 pre-crisis). Unfortunately, this number is considerably below

⁴ Issuances are from the Securities Industry and Financial Markets Association reports (SIFMA) from 2010 through the second quarter of 2015. These totals are estimates and may be missing smaller categories.

⁵ For example, see Azizpour, Giesecke and Kim (2011), Das, Duffie, Kapadia and Saita (2007), Giesecke (2004), Giesecke and Weber (2004), Koopman, Lucas and Schwaab (2012), Lando and Nielsen (2010), and Li (1999), among others.

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