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ABSTRACT

Collateralized Loan Obligations (CLOs) were one of the largest and fastest growing segments of the structured finance market, fueling the 2003-2007 boom in syndicated loans and leveraged buyouts. The credit crisis brought CLO issuance to a halt, and as a result the leveraged loan market dried up. Similar to other structured finance products, investors in CLOs rely heavily on credit rating provided by the rating agencies, yet little is known about CLO rating practices. This paper attempts to fill that gap. Using novel hand-collected data on 3,912 tranches of Collateralized Loan Obligations (CLO) we document the rating practices of CLOs and analyze their existing structures.

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1. Introduction

Collateralized Loan Obligations (CLOs) are Collateralized Debt Obligations (CDOs) backed predominantly by loans. CLOs played a key role in financing billions of dollars of private equity firms' leveraged buyouts around the world. As of 2006, Standard & Poor's Loan Syndications and Trading Association (S&P LSTA) estimated that structured investment vehicles like CLOs represented 60% of institutional participation in the syndicated loan market. The influx of capital from these investment vehicles was so extraordinary that the amount of capital committed to private equity in 2006 and 2007 reached record levels, surpassing the leverage buyout wave of the late 1980s (Kaplan and Stromberg (2008)). However, following the subprime mortgage crisis, investors lost confidence in structured finance credit ratings and CLO issuance virtually dried up. CLO issuance in the first quarter of 2008 was down 85% from the previous year's level.[3] Leveraged loan originations followed suit, falling 74% in the first quarter of 2008 compared to same period in 2007. Leverage buyout (LBO) lending slowed down to a near standstill in 2008 with issuance levels being the lowest in almost a decade. The rise and fall (and potential resurrection) of the CLO market has important implications for private equity and leveraged loans lending.

One important aspect of structured finance markets in general, and of the CLO market in particular, is the extent to which investor demand is driven by credit ratings. CDOs contain hundreds of underlying assets and modeling the payoffs to these securities requires sophisticated cash flow models. Investors rely on credit ratings as a focal point, yet there is little public information on how these ratings are calculated, and how ratings on CDO securities relate to the underlying collateral quality. While there is a growing body of literature that studies the credit

[3] SIFMA Global CDO Issuance Tables: http://www.sifma.org/research/pdf/CDO_Data2008-Q4.pdf

ratings of residential-mortgage backed securities and CDOs,[4] less is known about the credit ratings of CLOs. Our paper attempts to fill this gap by studying the relation between CLO credit ratings and the quality of the underlying collateral backing these securities. Using novel hand-collected data on 3,912 tranches of collateralized loan obligations (CLOs) we document the structure of CLO tranches and the credit quality of the underlying collateral supporting these tranches.

Collateralized Loan Obligations are interesting for several reasons. CLOs are the second largest segment of the CDO market, accounting for 30% of the dollar volume of securities issued.[5] While CLOs have not yet suffered downgrades or impairments as dramatic as those experienced by asset-backed CDOs and mortgage-backed securities, there is concern that the deepening recession may lead to deterioration in the credit quality of CLOs portfolios. We provide detailed information on underlying structures of CLOs to further the understanding of these securities, their structures, and credit ratings.

Similar to other structured finance products, a large fraction of the securities issued by CLOs are AAA rated. 70.7% of the value of securities issued by CLOs in our sample is rated AAA. Excluding unrated equity tranches, AAA tranches account for 79.2% of the dollar value of securities issued. In contrast to mortgage-backed securities, the assets in the collateral pools of CLOs are rated on the same scale as the liabilities, which facilitates an examination of the credit enhancement achieved through structuring. There is a large gap between the rating of CLO tranches and the credit quality of the underlying assets supporting these tranches. We find that 85% of the CLOs in our sample have collateral pools with a weighted average credit rating of B, 8% have a weighted average credit rating of BB, and for 7% the information is missing. We use

[4] See for example, Ashcraft and Schuermann (2008), Coval, Jurek, and Stafford (2008a) Coval, Jurek, and Stafford (2008b), and Mason and Rosner (2007).

[5] Between 2005-2008, only structured finance CDOs (CDOs backed by structured securities like RMBS, ABS, other CDOs, or CDS) accounted for a larger share of issuance (56%). See SIFMA Global CDO Issuance statistics.

the term "alchemy" to describe the mismatch between the credit ratings of CLO securities and the credit quality of the underlying collateral. We also document a large degree of uniformity among cash-flow CLOs; 63% of the CLOs in our sample had one of four major liability structures or deal types. Moreover, there is very little variation in the required composition of the collateral pools in the CLOs. We speculate that the uniformity of CLO structures is driven by a boiler-plate model that was used to rate CLOs targeting the highest possible credit rating at the lowest cost, while catering to investor demand.

The rest of our paper is organized as follows. In Section 2 we describe the market for CDOs, presenting statistics on global issuance and the economic motivation for CDO issuance. Section 3 describes our data. Section 4 presents our empirical analysis of the structure of CDOs and their credit ratings. Section 5 discusses the demand for highly rated structured products tranches. Section 6 concludes.

2. The Market for Collateralized Debt Obligations

Collateralized debt obligations (CDOs) are special-purpose vehicles that buy portfolios of assets and issue securities backed by the cash flows from those assets. The collateral assets, in turn, are sold to a special-purpose entity, often located in the Cayman Islands or Ireland, to ensure bankruptcy remoteness from the issuer. While the first CDOs were created in the 1980s, global issuance remained low, under $100 billion annually, until the mid-1990s.[6] Since 2002, CDOs have been the fastest growing sector of the asset-backed securities market.

2.1. The Economics of CDOs

[6] See Fabozzi (2006), p. 3.

The defining feature of CDOs and CLOs is their multi-tiered liability structure (see Figure 1). CDOs and CLOs issue multiple classes of financial claims with differing levels of seniority against diversified pool of assets. When assets in the collateral pool miss payments or default, subordinate tranches absorb losses first. More senior tranches only suffer losses once the cushion below them has been depleted.

The process of pooling of assets achieves diversification as long as the assets are not perfectly correlated, while structuring of tranches with different levels of seniority reallocates risk across different securities. In a Modigliani-Miller world with perfect markets, there would be no benefit to this kind of repackaging by tranching, however in the presence of various market imperfections, gains from tranching may exist. DeMarzo (2005) lists three types of market frictions that are important in explaining securitization: (i) transactions costs, (ii) market incompleteness, and (iii) asymmetric information. According to DeMarzo and Duffie (1999) and DeMarzo (2005), asymmetric information plays a key role in explaining the existence of tranched securities. DeMarzo (2005) notes that market incompleteness cannot explain the existence of pass-through pools or most CLOs because they do not augment the span of tradeable claims; additionally, transactions costs explain why pooling is valuable but not tranching. DeMarzo (2005) presents a model of a financial intermediary that would like to sell assets about which it has superior information. When the number of assets is large and their returns are imperfectly correlated, the intermediary maximizes his revenue from the sale by pooling and tranching, as opposed to simply pooling or selling the assets individually. Similar to the intuition in Myers and Majluf (1984), tranching allows the intermediary to concentrate the default risk in one part of the capital structure, resulting in a large share of the liabilities being almost riskless which in turn reduces the overall lemons discount that buyers demand. In order to create a large share of safe securities from a pool of very risky assets the issuer of a typical CLO needs to

enhance the creditworthiness of the most senior tranches of the deal. We illustrate the credit enhancement mechanisms in CLOs using a representative deal in the next subsection.

2.2 CLO Structure and Credit Enhancement: A Representative Deal

Table 1 illustrates the sources of credit enhancement in CLOs and the transformation of B-rated loans into AAA securities using a representative deal from our sample, Octagon Investment Partners V Ltd. Octagon Investment Partners V was a $300 million deal that closed on January 14, 2003, with a portfolio consists primarily of non-investment grade loans as well as a limited amount of high-yield bonds and structured finance securities.[7] The weighted average rating of the underlying collateral is BB-. The CLO financed the purchase of these assets with a mix of tranched liabilities: out of which 79% is AAA, 7% A, 5% BBB, 2% BB, and 8% unrated.

There are several sources of credit enhancement in CLO structures, which support the creation of investment grade claims backed by speculative grade assets: (a) diversification (b) overcollateralization and subordination (c) excess spread, and (d) the active management of the pool. The collateral guidelines of Octagon V indicate that the manager must maintain a minimum level of diversification in his portfolio. The maximum allowable concentration in securities from a single issuer is 2% ($6 million).[8] When losses do occur, investors in the higher-rated tranches are insulated from loss by the tranches subordinate to them. All of the rated noteholders benefit from the 'overcollateralization' provided by the equity tranche. Octagon V purchased assets with an aggregate principal balance of $300 million, issuing $276.75 million worth of rated notes. The difference, $23.25 million (8%) of the asset purchase, was financed by equity investors in the deal, who receive payments from interest and principal cash flows only

[7] Although 50% of deals in our sample were issued between 2004 and 2006, we describe a deal from 2003 because information about the spread on assets in the CLO portfolio is largely missing from S&P reports after 2003.
[8] Many deals also limit concentration within an industry to 8-12% of the portfolio, although this deal does not have that requirement.

after rated noteholders have been paid. Additionally, investors in the senior tranches of Octagon V are protected from loss by the mezzanine tranches of the deal. In Octagon V, 21% of the capital structure serves as a cushion against loss for those investors.

In cash-flow CLOs, subordination is achieved by distributing cash flows from the assets to investors in order of seniority. Panels C and D of Table 1 show the 'waterfalls' that govern how interest and principal cash flows from the collateral are allocated to investors in the deal. After taxes and administrative fees have been paid, interest receipts are used to pay CLO investors in the most senior class, A. As long as par coverage and interest coverage ratios meet their required levels (specified in the CLO indenture), interest flows down the capital structure to the next most senior class, B.[9] If the ratios are not met, proceeds must be used to pay down class A, and restore compliance before subordinate investors receive any payments. Preferred shareholders collect the residual interest after all the classes senior to them have been paid. In Octagon V, the manager has an incentive to make sure that the equityholders will receive a minimum IRR of 14% because his incentive fee is conditional on it.[10]

Another source of credit enhancement is excess spread. The weighted average spread on a CLO's assets typically exceeds the weighted average spread on its liabilities. In Octagon V, the weighted average spread on the assets expected at the time the portfolio is fully ramped is 3.125%[11] (Table 1, Panel E) while the weighted average spread on its liabilities is 87 basis points (Table 1, Panel A). Expected excess spread at the time of deal close is 2.26%. The deal requires the manager to maintain a minimum weighted average spread on assets of 2.75%, or excess spread of at least 1.88%. Octagon V, like most CLOs, is a revolving deal. The notes issued by

[9] Par coverage for a class = [total par of collateral assets + cash + defaulted securities at lower of MV or recovery] / [par value of securities outstanding in class & all classes senior]; Interest coverage for a class = [interest received during period + net swap payments]/[total amount of interest payable on the tranche]

[10] Not all structures have this feature. Another common setup is, after the interest-paying classes have been paid, the manager takes 50% of the residual as an incentive fee and the rest goes to equity.

[11] This calculation assumes 100% of the portfolio assets are floating rate for simplicity, although 10% of the portfolio can be fixed rate securities.

the CLO mature in November 2014. For the first five years of the deal (the 'reinvestment period'), the manager may use principal proceeds to reinvest in additional assets; after the reinvestment period, proceeds must be used to pay down notes. During the reinvestment period, the manager may also engage in limited trading, under certain conditions (Table 1, Panel F). Octagon V's manager can trade assets that decline or improve in credit quality and may also make discretionary sales, as long as those sales do not exceed 25% of the aggregate principal balance of the portfolio.[12] After sales and purchases, the issuer must run Standard & Poor's CDO Monitor to confirm that the portfolio satisfies coverage tests (overcollateralization and interest coverage limits by tranche) and collateral quality tests (portfolio concentration limits, weighted average spread tests, etc). If, at any point, overcollateralization or interest coverage tests are not satisfied, investors in the rated notes may force redemption in order of seniority. Octagon V also provides the issuer with the option to redeem the notes in full after a three-year non-call period, subject to the approval of more than 50% of the preferred shareholders

2.3. Collateralized Debt Obligation Types and Issuer Motivation

Table 2 presents summary statistics on global issuance of al types of CDOs for the period 2004-2008.[13] Issuance is broken down by type of structure and by issuer motivation. There are three main types of CDO structures: (i) cash-flow, (ii) synthetic, and (iii) market-value. Cash-flow structures are the most common (74%), with synthetic (14%) and market-value (10%) structures accounting for a much smaller share of issuance. A cash-flow CDO issues notes to investors and uses the proceeds to invest in primary financial assets such as loans, mortgages, bonds, etc. As interest and principal are generated by the underlying collateral, proceeds are distributed to

[12] A 25% limit for discretionary sales is relatively high; most CLOs limit this to 10-15% of the aggregate principal balance.

[13] The information in Table 2 is reproduction of data from the Securities Industry and Financial Markets Association (SIFMA) and Thomson Financial reports.

the CDO investors in a pre-specified way, in order of seniority. In contrast, synthetic CDOs obtain their credit exposure through derivatives contracts instead of assets purchases. A synthetic CDO issues notes to investors, invests the proceeds in risk-free securities, and enters into a series of credit default swaps (selling protection). Investors in a synthetic CDO receive periodic payments from swap premiums, and their principal is written down if the reference entities on the swaps default.[14] Market-value CDOs account for a growing share of the market. They are similar to cash-flow CDOs except the amount of liabilities the CDO can issue is determined by advance rates for each asset in the pool and collateral is marked-to-market frequently. When the liabilities outstanding exceed the advance rates, the manager must sell collateral and pay down notes until compliance is restored. While cash-flow CDOs can alter the credits in their collateral pools, trading is less frequent in cash-flow CDOs than in a market-value CDO.[15]

Table 2 also decomposes CDO issuance by issuer motivation. 86 percent of CDOs issued from 2004 through the first half of 2008 were arbitrage-motivated, rather than balance-sheet motivated. Arbitrage CDOs are typically sponsored by an investment manager or hedge fund that acquires assets on the open market and packages them into a CDO to earn management fees on the deal. Balance-sheet CDOs are motivated by a financial institution's desire to achieve relief from regulatory capital requirements or to free up capital for lending. Balance-sheet issuers are typically lending institutions. The arbitrage versus balance-sheet label is provided to Thomson Financial by the underwriter. We were unable to get any further details from Thomson about how the distinction is made, but an examination of the transactions labeled as balance-

[14] In contrast, investors in an unfunded synthetic CDO do not make any upfront payments. The CDO enters into default swaps and investors are required to post funds on-demand when reference entities default.

[15] Most managed cash-flow CDOs limit trading to certain types of securities (e.g. – defaulted securities, credit-risk securities for which the mark has widened by 100bp) and/or limit discretionary trading to 10-20% over the life of the CDO or annually.

sheet deals by S&P reveals that these transactions typically contain assets from a single originator.

3. Data and Sample Construction

Collateralized Loan Obligations are largely sold in private markets (registered under 144A or Reg S), hence data on their structures is not publicly available. The SDC Platinum New Issues database tracks issuance in these markets but assembling a sample of CDOs from these data is difficult due to inconsistencies in SDC's classification of CDOs.[16] Moreover, SDC Platinum only provides information on the liability side of the CDO (the notes that have been issued), but does not contain detailed information about the underlying collateral that supports the notes.

3.1. Sample Construction

We construct our sample of CLOs using Standard & Poor's RatingsDirect database, by hand-collecting micro-level data on the structure of a large sample of CLOs. The S&P data allows us to observe both the asset side and the liability side of a CLO, in addition to a host of information about the ratings decision. RatingsDirect provides real-time access to S&P's credit research and ratings for currently-rated fixed income securities. At the time we gathered the data, October 2007, the database contained 3,237 CLOs (1,704 cash-flow, 970 synthetic, and 563 market-value or hybrids). We focus on cash-flow CLOs for which the collateral is primarily corporate loans. There are 744 such transactions in the database, comprising 44% of cash-flow CLOs and 23% of all CLOs by number. This is the largest single category of CDO in Ratings Direct, by number.

[16] For example, SDC alternatively labels CDO tranches as floating rate notes, collateral bonds, preferred shares, and collateralized loan obligations.

Figure 2 plots issuance volume by year for our sample, while Table 2 reports the corresponding numbers for Figure 2. Our sample contains 531 cash-flow CLOs that were issued between 2000 and the third quarter of 2007.[17] The phenomenal growth of the CDO market is reflected in this segment of the market that we observe. From 2004 to 2006, the par value of issuance increased by about 75% annually. While the year 2007 was on track to surpass the record issuance numbers of 2006, the credit crisis brought CDO and CLO issuance to a complete halt. The small number of CLOs in our sample issued between 2000 and 2002 is due to the nature of the database. RatingsDirect drops securities that are not currently rated. Most cash-flow CLOs can be called or redeemed by the issuer after a five to seven year non-call period (subject to the approval of a majority of preferred shareholders), and it is likely that many issued in the early part of the window have been. Our results do not change if we exclude these CLOs from the analysis. Additionally, since the non-call period is typically at least five years, we have no reason to suspect that the CLOs in our sample that were issued post-2002 are subject to any selection bias. As Table 2 demonstrates, the majority of CLOs – 72% by amount, 75% by number over the whole period – are US-dollar denominated. Issuance of Euro-denominated CLOs increased over time from 20% of the dollar volume of issuance in 2002 to 36% in the first three quarters of 2007.

Figure 3 and Table 3 provide a detailed description of CLO deal structures. The average CLO in our sample has 7.3 tranches but deals range from 2 tranches to 21 tranches. Average deal sizes and tranche sizes have risen over time. In 2002, the median CLO issued securities totaling $397 million; by 2007, the median deal was $500 million. In 2002, the median tranche size was $17 million while, in 2007, the median tranche size was $35 million.[18]

[17] We get our descriptive data from S&P analyst reports, which were only available for 534/744 cash-flow CLOs. Reports for three of these CDOs were missing critical information hence the CDO sample size of 531.
[18] 2000 and 2001 have only 4 and 10 CLOs respectively.

For each CLO, we gather data from two sources in RatingsDirect: (i) an analyst report, Presale report or New Issue report, and (ii) Current Ratings reports. Around the time a transaction closes, S&P releases the Presale report or New Issue report: an analyst report summarizing the rating decision and the deal structure. We supplement the information from the Presale Report with data from the Current Ratings report. We also record the tranche structure in the Current rating report and check it against the structure in the analyst report.

Presale Reports are typically released two to three days before the expected closing date of a transaction. New Issue Reports appear anytime from one day to one year after a transaction has closed (the median is 73 days after). At least one of these reports is available for 534 of the 744 cash-flow CLOs in Ratings Direct. We hand-collected data from these reports, using the New Issue Report when available, otherwise the Presale Report. One concern about Presale reports is that they are issued prior to issue date, and may not reflect the actual collateral pool or the deal structure. To address this concern, we use the Current Ratings report, which has up-to-date information on tranche structures and ratings, to check whether actual deal structures match the ones in the Presale reports. In 405 out of 534 CLOs (75.8%), the tranche structures are similar across the two reports alleviating concerns about the accuracy of Presale reports.[19]

4. The Credit Ratings of CLOs

4.1. Credit-Rating Arbitrage and the Uniformity of CLO Structures

Managers of cash-flow arbitrage CDOs make money by buying assets such as loans in secondary markets, refinancing them by issuing tranches that are secured by these assets, and taking a share of the profits. Part of the cost-of-capital advantage that CLOs enjoy is due to their legal status as

[19]If any back-and-forth occurs between CLO arrangers and the rating agency it probably happens before any analyst reports are issued. .However, it is unlikely that such negotiations are necessary. S&P's CDO Evaluator software is distributed freely to arrangers so they know, for the most part (the rating agency may raise concerns that are outside the scope of the model, e.g., about the manager's track record), how changing the structure changes the amount of each class of rated notes that can be supported before the rating committee's review begins.

special-purpose entities,[20] but most of it is the result of structuring, which produces highly-rated securities. As their name suggests, cash-flow arbitrage CLOs exploit credit-rating arbitrage; in the process of pooling and tranching, low-rated securities are transformed into highly rated tranches.

Table 4 and Figure 4 decompose the par value of notes issued by credit rating. In the sample as a whole, 71% of issuance is rated AAA; 5% is AA, 6% is A, 5% is BBB, 2% is BB, 0.1% is B and 11% is NR (unrated). The composition of issuance across years is almost identical to the overall composition with a slight downward trend in the amount of AAA and an upward trend in the amount of unrated tranches over time. Table 5 presents a more detailed analysis of deal structures. We find that every CLO except one has an AAA tranche, and the median AAA tranche represents 73% of the deal's total value. Likewise, 98% of CLOs have an unrated tranche and the median tranche, conditional on having one, comprises 8.8% of the deal. The interquartile ranges show that there is little variation in the composition of rated tranches across deals. For example, 80% of CDOs have a AA tranche and the median AA tranche represents 6% of the deal's par value. The interquartile range for the size of AA tranches is [4.7%, 7.7%]. Issuing liabilities in notched rating classes (e.g., AA+ or AA-) is relatively uncommon for every rating letter category. We also document a large degree of uniformity among cash-flow CDOs. According to Panel A of Table 6, 63% of the CDOs in our sample had one of four major liability structures ("deal types"): 40% are {AAA, AA, A, BBB, BB, NR} deals; 13% are {AAA, AA, A, BBB, NR}; 7% are {AAA, AA, A, BBB-, BB-, NR}; 4% are {AAA, A, BBB, BB, NR}.[21] The remaining 137 deals have idiosyncratic structures that appear less than 20 times each.

[20] Not subject to capital requirements like most financial institutions and located in low-tax jurisdictions.
[21] These results do not distinguish between deals that have 1 tranche per rating class or multiple tranches per rating class.

4.2. The Uniformity of Collateral Restrictions

The majority of the CLOs in our sample are managed, that is collateral managers can engage in limited trading over the designated 'reinvestment period', typically the first 5-7 years of a 12-year CDO.[22] In managed CLOs, the credit quality of the pool is controlled by covenants in the deal that constrain the manager's asset allocation. Table 7 summarizes the frequency and nature of collateral composition restrictions in our sample. These restrictions fall into a few broad categories: (1) Restrictions on asset type, (2) Restrictions on the fraction of near-default securities in the pool, (3) Restrictions on the mix of fixed/floating rate securities and the payment frequency of the collateral, (4) Diversification requirements by industry and issuer, (5) Currency and domicile restrictions on collateral, (6) Rating restrictions.

Conditioning on the presence of any given restriction, there is very little variation in the magnitude of the restriction. For example, nearly 70% of the CDOs in our sample require a minimum fraction of the collateral pool be invested in senior secured loans. When this restriction is present, in 40% of the cases it takes the value of 90%, and the interquartile range is [85%, 90%]. Furthermore, 46% of CDOs restrict the amount of second lien loans as a percentage of total asset par; the median limit is 10% and the interquartile range is [10%, 12.5%]. Likewise, 60% of CDOs limit the amount of structured finance collateral as a percent of total asset par; the median limit is 5% and the interquartile range is [3%, 5%]. We find similar clustering on all other types of restrictions. According to S&P, collateral constraints "are specified by the sponsor, banker, and collateral manager based on their perceptions of what the investor community wants and can be comfortable with" (Global Cash Flow & Synthetic CDO Criteria, p. 19-21). In the rating process, and as ratings are monitored during the life of the CDO, collateral restrictions only affect tranche ratings insofar as default, correlation, and recovery rates

[22] Typically 10-15% of the par value of assets may be traded per year in addition to securities defaulted securities or credit-risk securities.

assumed for individual assets depend on asset class, rating, maturity, and domicile. (We explain the details of the rating model in Section 5.1). That is, there is no additional penalty vis-à-vis the rating agencies for including for example more than 5% of structured finance collateral. The uniformity in collateral restrictions suggests that investors may to some extent rely on simple rules to judge the riskiness of these complex and idiosyncratic structures. Additionally, there is reason to believe that rating agencies influence investor perceptions of what constitutes an acceptable allocation of collateral. S&P's Presale and New Issue reports have a 'Strengths, Weaknesses, and Concerns' section where they highlight collateral characteristics that they deem unusually risky; often this involves pointing out when allocations to certain baskets (e.g., rated below CCC+, structure finance securities, etc) exceed levels seen in Table 7.

4.3. The Alchemy of CDO Credit Ratings

We now turn to analyze the relation between the underlying collateral quality, and the credit rating of the secured tranches. Our main measure of collateral quality is the weighted average rating (WAR) of all the assets in the pool. The WAR is reported in the Presale reports and is calculated as a weighted-average of all the loans, bonds and securities in the collateral pool. S&P requires that every asset in the pool will have either an actual or assessed credit rating. One concern about weighted-average rating as a measure of collateral quality is that it does not sufficiently describe the riskiness of the collateral pools. Two portfolios with the same WAR could have very different loss distributions. Consider, for example, a portfolio that contains only B-rated securities versus a portfolio that contains some AA securities pooled together with many CCC-rated securities or near-default loans. However, based on the collateral restrictions we

observe, it seems likely that most of the collateral in a CDO with a WAR of B is probably, in fact, B-rated.[23]

We find that 85% of the CLOs in our sample have collateral pools with a WAR of B, 8% have a WAR of BB, and for 7% the information about WAR is missing.[24] As Panel B of Table 6 demonstrates, we do not find any correlation between deal type and WAR of the collateral pool; each type of deal is more likely to be backed by collateral with an average rating of B than BB. It is interesting to note that there is a trend in weighted-average collateral quality over time: with BB-backed CDOs all but disappearing by 2006-2007. This deterioration in average collateral quality over time implies that debt or equity investments in later CDOs are potentially riskier.

As is typical in structured finance products, there is a gap between the credit ratings on the notes issued by CDOs and the credit quality of the underlying collateral. Figure 5 quantifies the ratings transformation that takes place in our sample of CDOs. Cash-flow CLOs finance the purchase of junk-rated assets (typically B+) largely with AAA-rated borrowings. While 70.7% of the dollar amount of CDOs in our sample was initially rated as AAA, the collateral that supports these issues had an average credit rating of B+.

4.4. How Does the CLO Credit Rating Model Work?

In this subsection we review the process that S&P uses to determine credit ratings for CLO tranches. The rating process for cash-flow CLOs involves two steps. In the first stage, an expected loss distribution for the underlying collateral pool is estimated. In the second stage, cash flow simulations are used to determine whether a tranche can withstand the necessary level of defaults to earn a given rating. The model requires many assumptions about default

[23] Sixty percent of CDOs restrict the amount of collateral that can be rated CCC+ or lower to five to seven percent of the portfolio.
[24] These are compressed ratings. The full WAR distribution is: 0.2% BBB-, 0.6% BB+, 0.4 BB, 7% BB-, 65% B+, 16% B, 4% B-, 0.2% CCC+, 7% missing data.

probabilities, correlation, interest rate movements, and more. The model generates two key statistics that determine the level of credit enhancement of each of the tranches in a CLO deal. The first statistic, calculated for each tranche, is S&P's 'scenario default rate' (SDR). The 'scenario default rate' is the level of default in the collateral pool that a tranche must be able to withstand to earn its rating. SDRs allow us to characterize, at least partially, the loss distribution that was estimated in the rating process for each collateral pool. The second statistic – 'break-even default rate' (BEDR) indicates the level of portfolio defaults that each tranche can withstand, according to the underwriter's cash-flow models

To estimate an expected loss distribution for a CLO's collateral, S&P uses historical data on rating transitions from its CreditPro database (1981-present).[25] Each asset in the collateral pool is assigned an expected default probability based on asset class (corporates, ABS, sovereigns, etc), rating, and maturity.[26] Some simple assumptions are made about default correlation. For example, two corporate securities in the same sector are assigned a 0.15 correlation; while corporate securities from different sectors obtain a correlation of 0.05.[27] Monte Carlo simulation is used to generate the distribution of portfolio losses. S&P then uses this loss distribution to generate a "scenario default rate" (SDR) for each tranche – this is the level of portfolio losses that a tranche must be able to withstand in cash flow simulations to earn its rating.[28] There are two steps in calculating the SDR. First, S&P identifies the default rate on

[25] Calculations may be based on the expected composition of the asset pool to some extent because only 50-70% is typically ramped up at the closing date.
[26] According to the CDO Evaluator Technical Document, p. 5-6, S&P calculates a one-year transition matrix from historical data and generates predicted default rates by raising it to higher powers. Appendix 1 of this document shows the one-year transition matrix and the predicted default rates (up to 30yrs). This methodology implicitly assumes that current rating is the only determinant of the likelihood of default.
[27] Standard & Poor's "CDO Evaluator 3.0: Technical Document", p.22. This document describes version 3.0 of the CDO Evaluator Model which was released in December 2005. In previous versions, correlation assumptions for corporates were 0.30 within industry and 0.00 across industries (Standard & Poor's "Global Cash Flow and Synthetic CDO Criteria, p. 46 and Standard & Poor's "S&P Launches Latest Version of CDO Evaluator Modeling Tool", p. 2).
[28] According to S&P "withstand" means to pay timely interest and ultimate principal by the final legal maturity of the notes.

corporate bonds that have the same rating as the one being sought for the tranche and maturity equal to the weighted-average maturity of the CDO's assets ("x%"). Then, using the loss distribution generated for the collateral pool, they identify the default rate that has no greater chance of being exceeded than x%; this is the SDR.

Consider a CDO tranche backed by collateral with a weighted-average maturity of 10 years that is being tested for an A rating. If the expected default rate of a 10-year A-rated corporate bond is 3%, the SDR for the tranche is set equal to the level of default in the CDO's collateral pool that has no greater than 3% chance of being exceeded. When the underwriter runs cash-flow simulations, he will test that the tranche can withstand cumulative defaults up to the SDR without missing interest or final principal payments. The logic is "if the tranche can survive defaults up to the SDR then its probability of default is no greater than 3%, as would be appropriate for an A rating" (Global Cash Flow and Synthetic CDO Criteria, p. 42).

SDRs allow us to back out, partially, the loss distributions that were estimated for each CLO's collateral pool. For example, the loss distribution for a CLO backed by a pool of assets with a weighted average maturity of seven years must satisfy: [29]

$\Pr(\text{asset defaults as \% of total par} > SDR_{AAA}) \leq$ default rate of 7 year, AAA-rated corporate bond = 0.14%

$\Pr(\text{asset defaults as \% of total par} > SDR_{AA}) \leq$ default rate of 7 year, AA-rated corporate bond = 0.40%

$\Pr(\text{asset defaults as \% of total par} > SDR_{A}) \leq$ default rate of 7 year, A-rated corporate bond = 0.96%

$\Pr(\text{asset defaults as \% of total par} > SDR_{BBB}) \leq$ default rate of 7 year, BBB-rated corporate bond = 4.6%

$\Pr(\text{asset defaults as \% of total par} > SDR_{BB}) \leq$ default rate of 7 year, BB-rated corporate bond = 14.1%

$\Pr(\text{asset defaults as \% of total par} > SDR_{B}) \leq$ default rate of 7 year, B-rated corporate bond = 32.2%

[29] Seven-year default rates were taken from the credit curves in Appendix 1 of "CDO Evaluator Version 3.0: Technical Document", which are calculated by repeated application of a 1-yr transition matrix. It is unclear whether these are the correct figures, because these default rates do not control for the maturity of the issue; however, we could not locate any other statistics on corporate bond default rates by maturity published by S&P. For a comparison, Moody's default rates for corporate bonds with 7-year maturities are Aaa=0.31%, Aa=0.55%, A=0.78%, Baa=2.86%, Ba=15.32%, B=35.55% (Moody's Default & Recovery of Corporate Bond Issuers)

Figure 6 illustrates the relationship between the loss distribution and SDRs.

Table 8 summarizes SDRs by tranche rating for our sample. As the table shows, median SDRs by rating class are: AAA=41%, AA=37%, A=32%, BBB=26%, BB=20%. Assuming, for simplicity, that all CDOs have assets with a weighted-average maturity equal to the sample mean (7-years), the typical CDO in our sample is backed by collateral that has an expected loss distribution like the one below:

Pr (defaults as % of total asset par> 41%) ≤ 0.14%

Pr (defaults as % of total asset par>37%) ≤ 0.40%

Pr (defaults as % of total asset par>32%) ≤ 0.96%

Pr (defaults as % of total asset par>26%) ≤ 4.6%

Pr (defaults as % of total asset par>20%) ≤ 14.1%

An AAA tranche is a tranche that can withstand the cumulative default rate that has no greater than 0.14% of being exceeded (41%). An AA tranche is one that can withstand the cumulative default rate that has no greater than 0.40% of being exceeded (37%). Clearly this methodology relies on estimating the loss distribution with a high degree of precision. Yet small changes in correlation assumptions can have dramatic effects on the right tail of the loss distribution.

5. CLO Ratings and Investor Demand

Similar to many other structured finance products, most of the liabilities of CLOs are AAA-rated. In the previous section we described the credit rating model used to generate the supply of AAA tranches. In this section we suggest that to a large extent CDO structures - and in particular their AAA-rated tranches - are driven by investor demand, which in turn is potentially driven by rating-dependent regulation, asymmetric information, and investor guidelines and heuristics.

5.1. Rating-dependent Regulation

Extensive use of credit ratings in the regulation of financial institutions created a natural clientele for CDO and CLO securities. According to Hunt (2008), at least 44 SEC rules and forms incorporated agency ratings as of June 2008. Minimum capital requirements at banks, insurance companies, and broker-dealers, depend on the credit ratings of the assets on their balance sheets.[30] Pension funds, a $10 trillion source of capital in the United States, also face ratings-based regulations. A recent survey of two hundred pension plan sponsors and investment managers in the US and Europe (Cantor, Gwilym, and Thomas, 2007) found that 75% have minimum rating requirements for bond purchases and 50% set limits on portfolio distribution by rating class. Meanwhile, modifications to the Employee Retirement Income Security Act of 1974 (ERISA) over the past twenty years have gradually expanded the range of structured finance securities that pension funds can hold.[31] This matrix of regulation creates institutional demand for highly-rated securities, yet the supply of highly-rated single-name securities is fairly limited. For example, only five nonfinancial companies and a few sovereigns had AAA ratings as of 2007. Thus, it is not surprising that highly rated CDO securities, especially those that are rated AAA, are attractive to many of these financial institutions. Highly-rated CDO securities incur smaller capital charges, may be used as collateral, and provide a higher yield than single-name securities with the same rating. Moreover, private investors not subject to rating-based regulation, may develop internal investment rules using credit ratings as inputs even when not required by regulation to do so.

5.2. Heuristics and Asymmetric Information

[30] Basel II allows banks to choose between two methodologies for calculating capital requirements for credit risk. The standardized approach, a modification of Basel I, is credit-rating based. The internal ratings based (IRB) approach allows banks us their internal estimates of risk components (e.g., expected default, loss given default, unexpected loss) to calculate the capital required for a given exposure. (http://www.bis.org/pubs/bcbs107b.pdf)
[31] In 1989, the Department of Labor began allowing ERISA plans to invest in highly-rated asset-backed securities with the passage of Prohibited Transaction Exemption (PTE) 89-88.

Ratings-based regulation explains some of the demand for highly-rated securities, but does not fully explain why we see so much AAA in CDO structures, as opposed to AA or A. Behavioral economics provides some insight as to why investors might demand AAA securities even in the absence of rating-dependent regulation. As described above, according to DeMarzo (2005) under asymmetric information, a CLO issuer maximizes his revenue from the sale by pooling and tranching, which results in the concentration of the default risk in few tranches. According to Demarzo's model, in order to alleviate any concerns about adverse selection in the securities issued by the CLO arranger, these securities would need to be certified as risk-. If investors use heuristics to classify assets, as in Barberis and Shleifer (2003), and only AAA-rated securities are perceived to be riskless then issuers would cater to investor demand by carving out large portions of their collateral pools as AAA.

5.3. Investor Demand and the Supply of Uniform Securities

While it is difficult to quantify the extent to which regulation, heuristics, or asymmetric information, individually drive demand for CLO securities, the uniformity of CLO structures suggests that investor demand in general is an important determinant of their structures. Uniformity reduces the amount of time investors must spend analyzing a new deal by making it easy to identify deviations from commonly used practices. If some CLO structures have been perceived as more desirable then other issuers will follow the same convention. Anecdotal evidence suggests that the S&P rating model was known to CLO issuers and was provided to them by the rating agency. Figure 7 displays excerpts from the CDO Evaluator Manual which we have downloaded from S&P's website. The CDO Evaluator software enabled issuers to structure their CDOs to achieve the highest possible credit rating at the lowest possible cost. For example, Figure 7 shows that one of the outputs that the CDO Evaluator provides to the issuer is "excess

collateral" which, according to S&P, "**tells what percentage of assets notional needs to be eliminated (added) in order for the transaction to provide *just enough* (i.e. ROC equals to 100%) support at a given rating level.**"[32] In other words, the model provided a sensitivity analysis feature that made it easy for issuers to target the highest possible credit rating at the lowest cost.

6. Conclusions

The innovation represented by Collateralized Loan Obligations has been instrumental to the growth of the syndicated loan market. By creating highly-rated securities out of junk quality loans, CLOs have brought new investors into the loan market - rating-constrained institutions that would not be allowed to hold the non-investment grade loans directly – and helped to finance a record-breaking leveraged buyout wave from 2003 to 2007. While CLOs have not yet suffered downgrades or impairments as those experienced by asset-backed CDOs, there are some signs that the deepening recession is causing deterioration in the quality of outstanding loans that serve as collateral for CLOs. Table 9 displays collateral performance by vintage as been reported recently by S&P. As the Table demonstrates, the fraction of assets rated BB and B has declined, while the share of assets rated CCC or those in actual default (D) increased across most vintages. These changes reflect the transition of assets from BB and B ratings to CCC and D within CLOs' collateral pools as a result of the current recession and credit crisis. While most of the effect of the decline in collateral quality led to downgrades of mezzanine tranches of CLOs rather than the most senior tranches, if this trend continues, more senior tranches may be affected as well.[33] The

[32] See Rajan, Seru, and Vig (2008) who provide evidence that securitization led to loans with worse fundamentals due to the tendency to rely on statistical models and reduction in the incentives to collect soft information.
[33] CLO managers may be required to sell defaulted loans if they violate collateral quality requirements, however secondary markets for loans have dried up as well, which may result in loan fire-sales.

future of CLOs as well as the resurrection of the leveraged loan market will likely be determined by the ability of CLOs to withstand corporate defaults.

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Figure 1: Typical CDO Structure

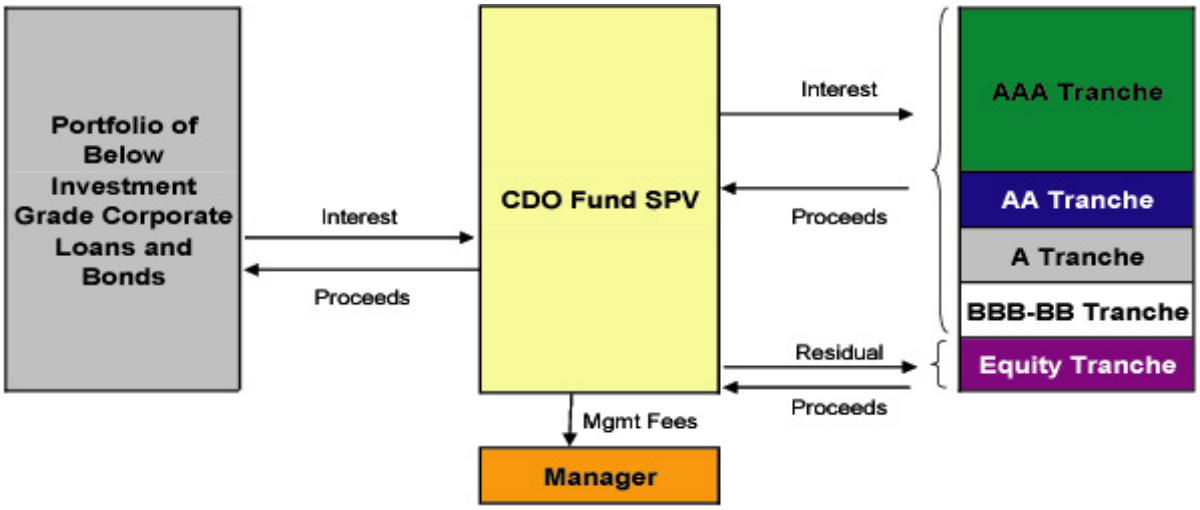


Figure 2: CDO Issuance by Year

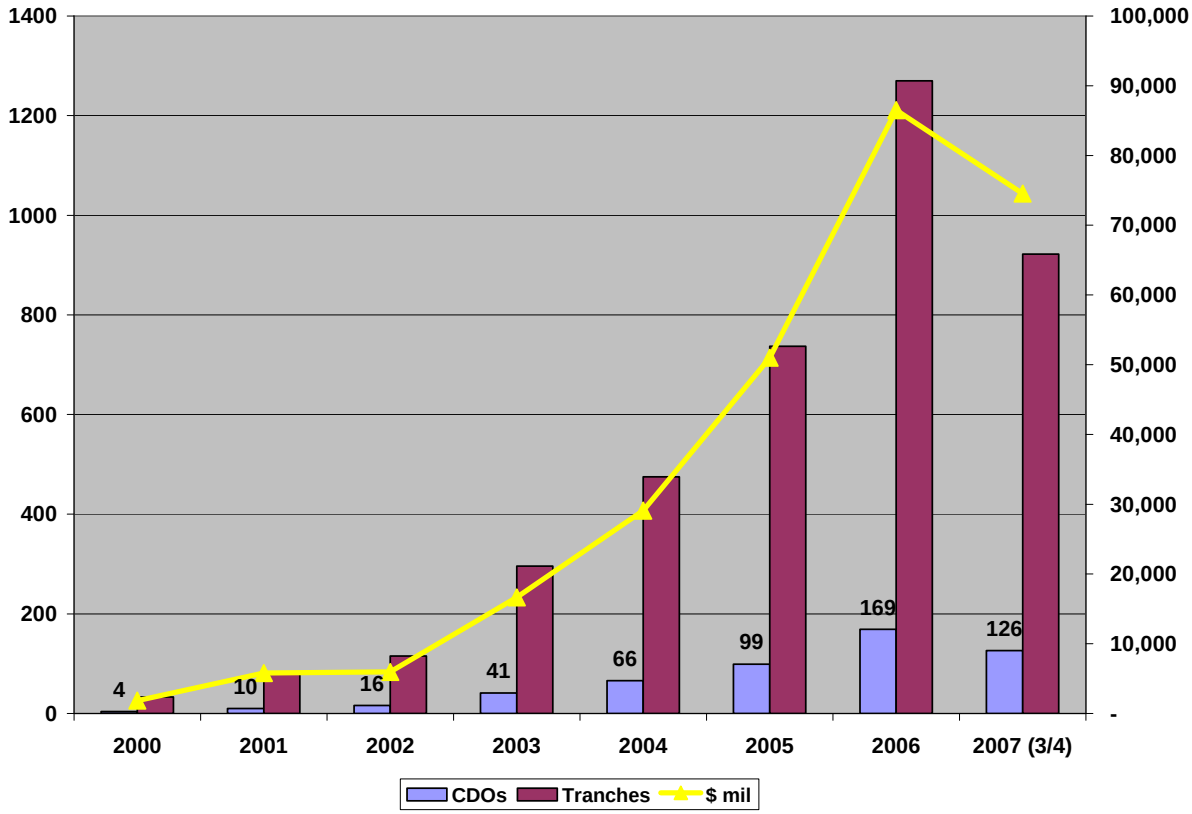
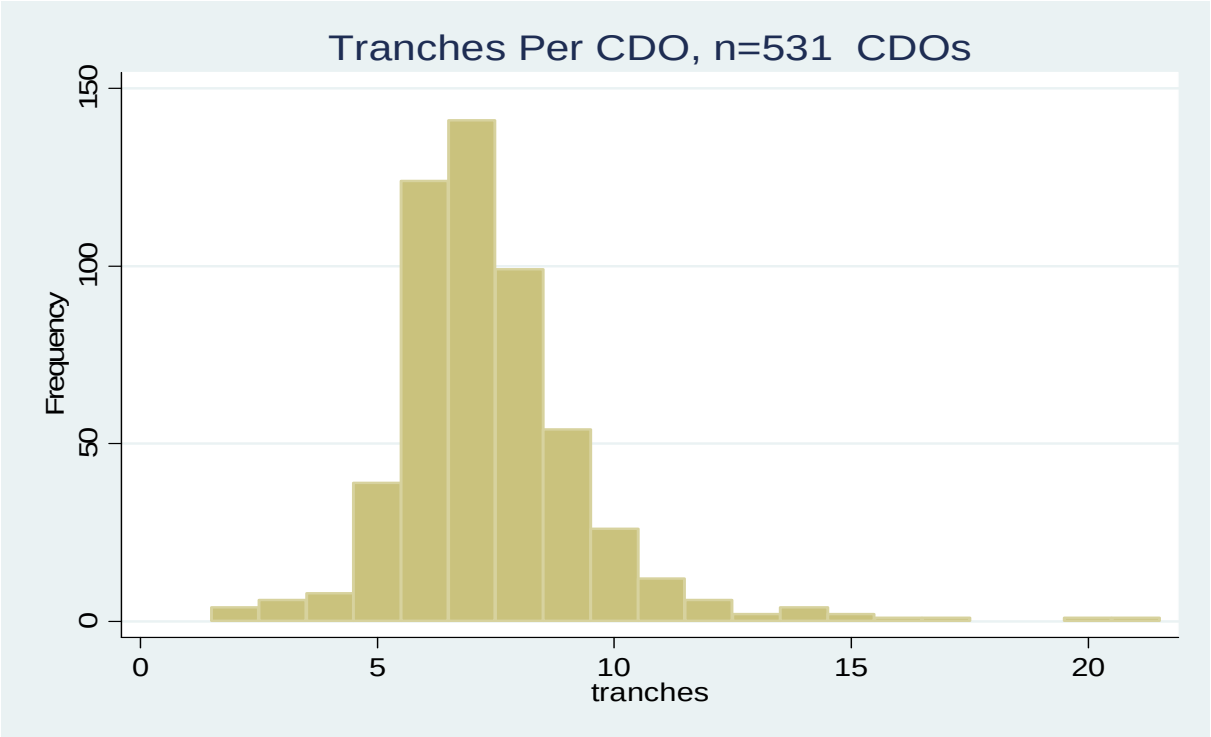


Figure 3: The Distribution of the Number of Tranches per CDO



Total number of CDOs	Total number of tranches	Mean number of tranches	Std of number of tranches	Min number of tranches	Max number of tranches
531	3,920	7.37	7	2	21

Figure 4: CDO rating Structure

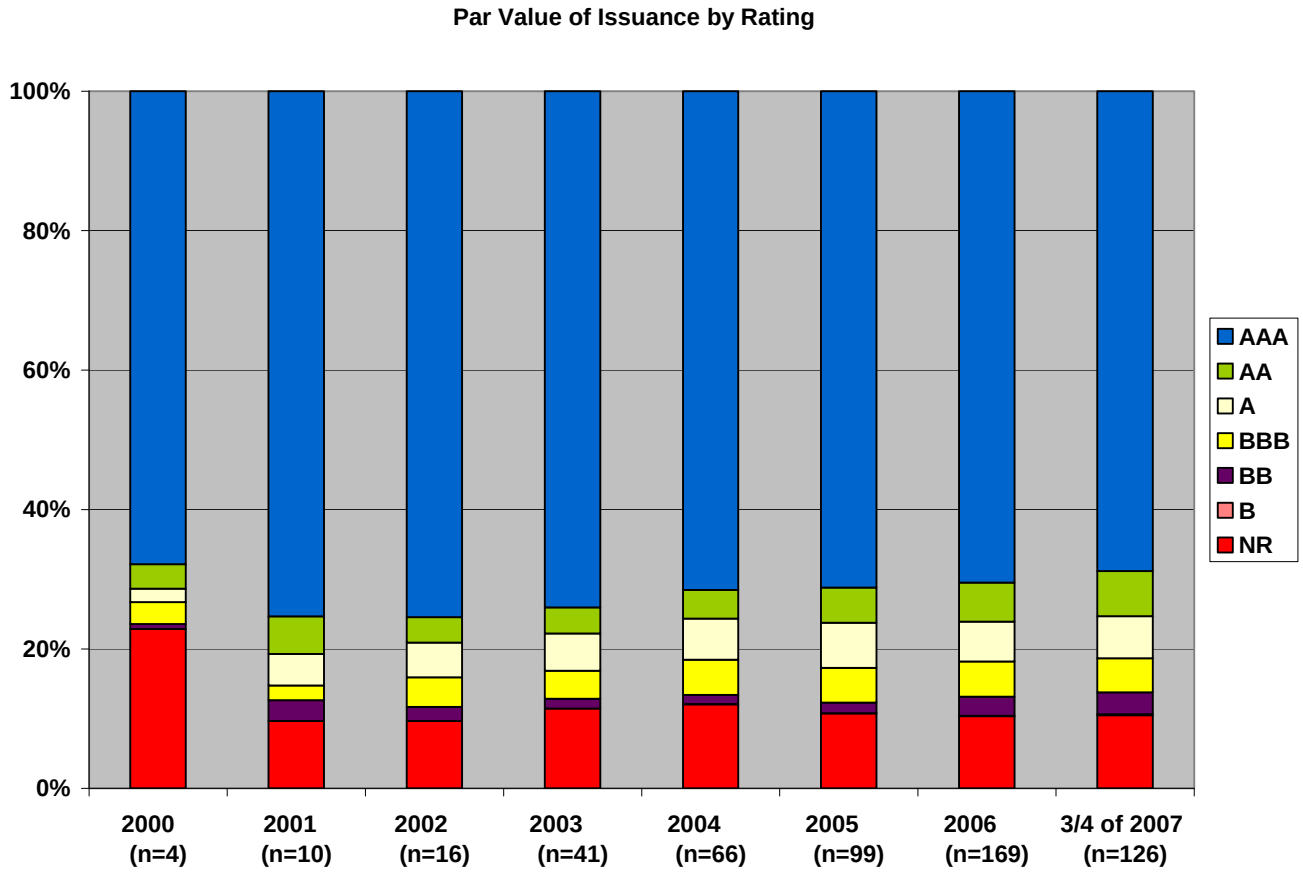


Figure 5: CDO vs. Underlying Collateral Credit Ratings (3,912 tranches)

This figure compares the credit rating of CDO tranches with the average credit rating of the underlying collateral pools that back them. The height of the bars pertaining to the tranche ratings represents the total par value of CDO securities issued with a given rating. The height of the bars pertaining to the underlying collateral represents the total par value of the CDOs where each CDO's par value is allocated based on the weighted average rating of the underlying collateral pool. The sum of the heights of the blue bars equals the sum of the heights of the red bars.

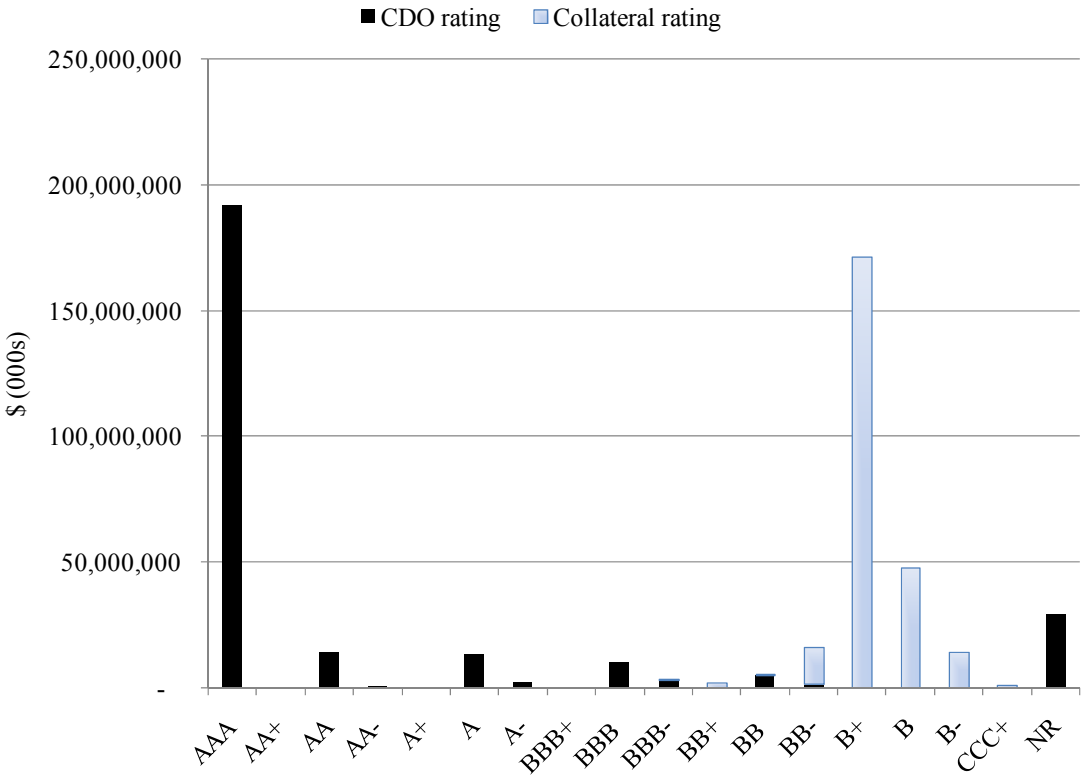


Figure 6: Calculating Scenario Default Rates

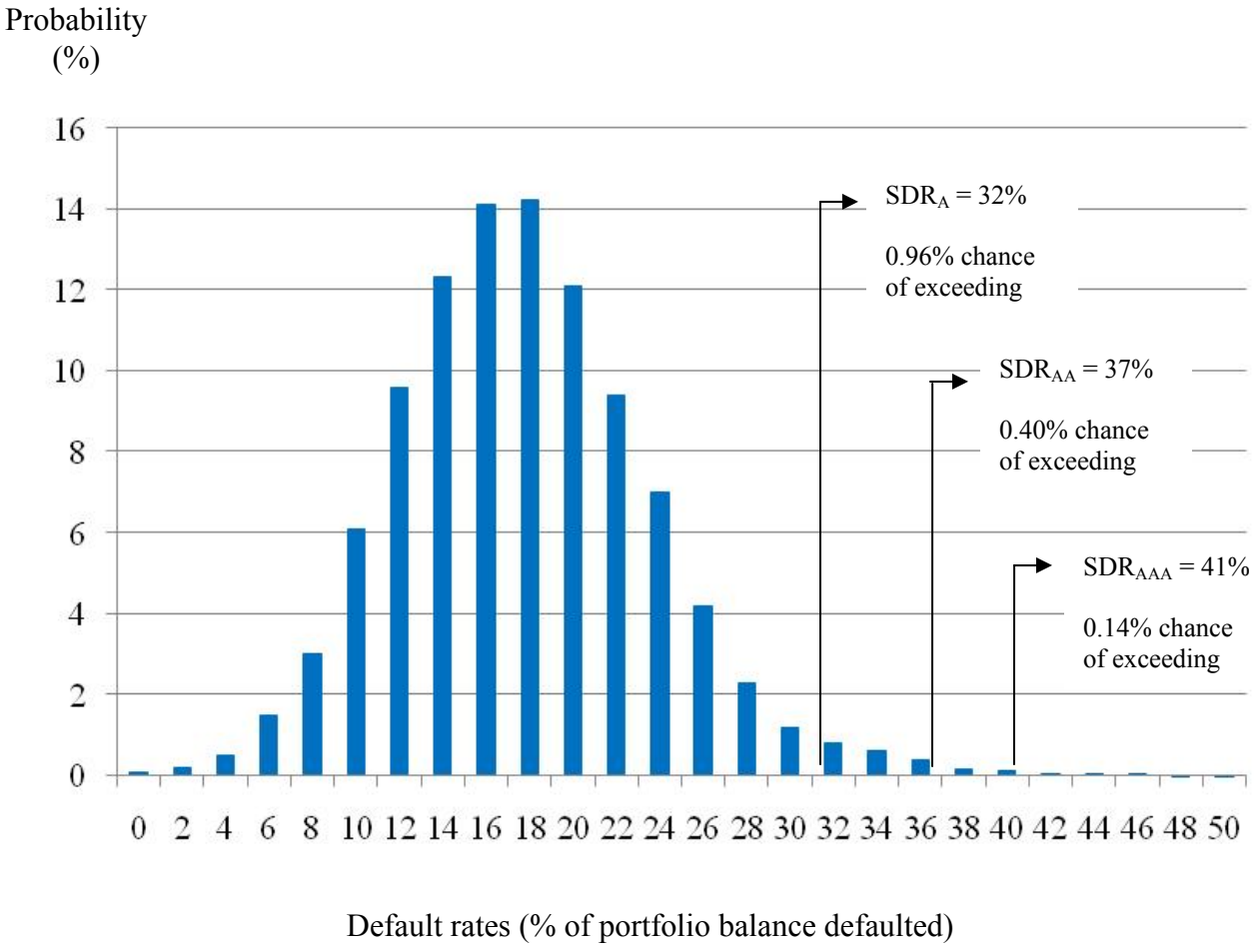


Figure 7: S&P CDO Evaluator

STANDARD &POOR'S

Version 3.0

CDO EVALUATOR HANDBOOK

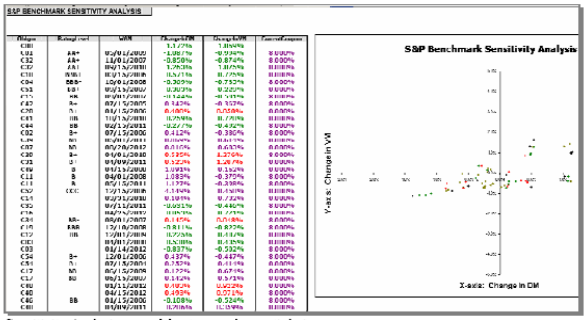
An introduction to and operational overview of Standard & Poor's CDO Evaluator tool, an automated spreadsheet application used for rapid, complex evaluation of the credit quality of CDO asset portfolios

STANDARD & POOR'S
STRUCTURED FINANCE GROUP
FEBRUARY 2006

2.10. Viewing Sensitivity Analysis

To perform Standard & Poor's benchmark sensitivity analysis on the current CDO, select the **S&P Benchmark Sensitivity Analysis** box on the *Run SDR/SLR* window (described in *Section 2.4. Running SDR and SLR Analysis* on page 37).

The sensitivity analysis is generated during SDR/SLR calculations and the results are displayed on the *Sensitivity Analysis* spreadsheet.



Sensitivity Analysis spreadsheet example, partial view

Sensitivity analysis generates a table of estimates indicating the effect of small changes in the par balance of each asset, along with an offsetting change in the par balances of the other assets, on the following figures:

* = REQUIRED INPUT

FIELD	DESCRIPTION
PERFORMING ASSETS AFTER SDR	Net asset balance of performing assets after taking out the defaulted amount based on the SDR stress, commensurate with a tranche rating. Computed as Perf.Coll.Balance*(1-SDR).
RECOVERY AMOUNT	Recovered amount that is expected to be collected on the projected defaults under SDR stress. Computed as Perf.Coll.Balance*SDR*Rec.Rate.
PV OF NET COUPON SPREAD	Principal equivalent of the excess spread left in the deal at the current tranche level.
TOTAL PRINCIPAL SUPPORTABLE	Sum of all three above components, represents tranche notional that can be supported at the given rating level.
LIABILITIES SENIOR & PARI PASSU	Actual notional amount of tranches outstanding at a given tranche level (includes all senior and pari passu tranches).
RATED OC (ROC)	The ratio of total principal supportable to liabilities senior and pari passu. Represents the effective over-collateralization at a given rating level, i.e.. how much notional can be supported vs. how much is actually issued (remains).
EXCESS COLLATERAL	Alternative representation of OC at each rating level, derived from ROC as follows: Excess Collateral = 1- 1/ROC. This tells what percentage of asset notional needs to be eliminated (added) in order for the transaction to provide *just enough* (i.e. ROC equals to 100%) support at a given rating level.

Table 1: Payment Priority Structure for Octagon Investment Partners V Ltd.

Panel A: Tranche Structure (CLO Liabilities)

Class	Rating	Original Principal Balance	Interest Rate
A	AAA	US$ 236,250,000	3-MONTH LIBOR + 60.00bp
B	A	US$ 21,000,000	3-MONTH LIBOR + 175.00bp
C	BBB	US$ 15,000,000	3-MONTH LIBOR + 300.00bp
D	BB	US$ 4,500,000	3-MONTH LIBOR + 825.00bp
Pref. shares	NR	US$ 23,250,000	Residual

Panel B: Collateral Profile (CLO Assets)

Weighted average rating	BB-
Weighted average maturity	5.84
Expected portfolio default rate	14.34%
Standard deviation of expected portfolio default rate	4.12%

Panel C: Interest Waterfall

Priority	Payment
1	First, taxes, filing, and registration fees; second, trustee fees; third, capped administrative expenses
2	Hedge payments
3	Senior management fees
4	Class A interest
5	Class A coverage tests. If fail, pay down class A
6	Class B interest.
7	Class B coverage tests. If fail, pay down class A and then class B. I
8	Class B deferred interest
9	Class C interest
10	Class C coverage tests. If fail, pay down class A, class B, and then class C.
11	Class C deferred interest
12	Class D interest
13	Class D coverage tests. If fail, pay down class A, class B, class C, and then class D.
14	Class D deferred interest.
15	During the reinvestment period, if class D overcollateralization test is not satisfied, deposit to collection account as principal until class D reinvestment O/C test is satisfied.
16	Deposit to collection account as principal proceeds amount that principal proceeds were used to pay (1)-(4), (6), (8), (9), (11), (12), and (14) above.
17	Subordinated hedge termination payment
18	Payments due in clause 1 above the capped amount
19	Subordinated management fee
20	At the discretion of the collateral manager, with the consent of a majority of the preference shares, to deposit in the collection account as principal
21	Preference shares up to an internal rate of return (IRR) of 14%
22	If IRR is 14% or greater, 20% of remaining interest proceeds to the collateral manager as an incentive management fee and 80% of any remaining interest proceeds.

Panel D: Principal Waterfall

Priority	Payment
1	Items 1 to 14 in the interest waterfall
2	If payment date is a redemption date, the redemption prices of all the notes and any preference shares to be redeemed. If payment date requires a special redemption, pay sequentially A, then B then C then D, until each note is paid in full as required. If payment date requires a partial redemption, pay pro rata to the class A, B, C, and D notes and the preference shares.
3	During the reinvestment period to purchase additional collateral
4	After the reinvestment period, pay down class A notes until paid in full
5	After the reinvestment period, pay down class B notes until paid in full
6	After the reinvestment period, pay down class C notes until paid in full
7	After the reinvestment period, pay down class D notes until paid in full
8	After the reinvestment period, to the payment of (17)-(19), (21) and (22) of the interest waterfall.

Panel E: Expected Portfolio Characteristics

	Expected On Effective Date	Required
Weighted average spread (%)	3.125	2.750
Weighted average coupon (%)	8.750	8.500

Panel F: Sale and Reinvestment of Collateral Restrictions

The transaction structure permits the collateral manager to sell collateral debt securities under the following conditions:

- The collateral debt security is a defaulted security, a workout asset, or a current pay obligation
- The collateral debt security is an equity security
- The collateral debt security is deemed a credit risk security
- The collateral debt security is deemed a credit-improved security
- The collateral debt security is subject to withholding tax
- As a result of an optimal redemption
- As a result of a rating confirmation failure on the effective date

The transaction also allows the collateral manager to sell collateral debt securities outside the requirements set forth above, if the total volume of these sales does not exceed 25% of the aggregate principal balance of the collateral debt securities for a given annual period.

Table 2: Global CDO Issuance Volume ($mil)

This table reproduces global CDO issuance statistics from the Securities Industry and Financial Markets Association (SIFMA). Issuance is broken down by type of structure and by issuer motivation. The original data is available at http://www.sifma.org/research/global-cdo.html

		BY TYPE:						BY ISSUER MOTIVATION:			
	TOTAL $	Cash Flow & Hybrid		Synthetic Funded		Market Value		Arbitrage		Balance Sheet	
		$	%	$	%	$	%	$	%	$	%
2004	157,418	119,531	76	37,237	24	650	0	146,998	93	10,419	7
2005	271,803	206,225	76	64,957	24	620	0	227,403	84	44,399	16
2006	551,709	414,743	75	89,042	16	47,924	9	472,197	86	79,511	14
2007	502,978	362,651	72	46,230	9	94,096	19	436,102	87	66,876	13
2008 – 1H	36,807	26,190	71	1,212	3	9,404	26	28,855	78	7,951	22
Total	1,520,715	1,183,340	74	238,678	16	152,694	10	1,311,555	86	209,156	14

Panel B: Sample Issuance Volume

	All CDOs			US$ denominated			Euro denominated		
Year	**CDO (#)**	**Tranches (#)**	**Total ($mil)**	**CDO (#)**	**Tranches (#)**	**Total ($mil)**	**CDO (#)**	**Tranches (#)**	**Total ($mil)**
2000	4	33	1,840	4	33	1,840	0	0	0
2001	10	74	5,793	8	60	4,577	2	14	1,216
2002	16	115	5,955	13	88	4,789	3	27	1,166
2003	41	297	16,666	35	244	14,613	6	53	2,053
2004	66	477	29,137	53	354	22,785	13	123	6,353
2005	99	741	51,139	80	573	40,313	19	168	10,826
2006	169	1,261	86,573	126	909	62,620	43	352	23,953
2007*	126	922	74,521	86	622	47,943	40	300	26,579
Total	531	3,920	271,624	405	2,883	199,479	126	1,037	72,145

Table 3: CDO and tranche size ($mil)

Panel A Summary Statistics for CDO size							
Year	**Mean**	**25th Percentile**	**Median**	**75th Percentile**	**Std**	**Min**	**Max**
2000	460	401	414	519	102	400	612
2001	579	438	511	750	194	321	895
2002	372	307	397	432	72	250	482
2003	406	306	356	439	165	212	1,023
2004	441	354	408	500	162	200	1,107
2005	517	364	499	600	209	210	1,250
2006	512	400	467	544	254	286	3,000
2007	591	424	500	647	343	300	3,529
Entire sample	512	400	460	557	257	200	3,529
Panel B Summary Statistics for Tranche Size							
2000	56	15	23	37	90	1.2	365
2001	79	11	22	50	145	1.8	654
2002	54	8	17	34	90	2.0	381
2003	58	10	19	41	96	0.5	847
2004	63	12	24	45	99	0.1	633
2005	69	15	27	57	108	0.02	681
2006	69	18	29	53	106	1.0	1,080
2007	81	23	35	72	124	0.5	1,849
Entire sample	70	16	28	57	109	0.02	1,849

Table 4: Par Value of Notes Issued by CDOs, by Rating (in $ mil)

	2000	2001	2002	2003	2004	2005	2006	2007	Total
AAA	1,248 (67.8%)	4,363.9 (75.3%)	4,490.8 (75.4%)	12,316.2 (73.9%)	20,799.0 (71.4%)	36,293.7 (71.0%)	60,962.4 (70.4%)	51,284.0 (68.8%)	191,757.9 (70.6%)
AA	65.0 (3.53%)	312.6 (5.4%)	218.0 (3.7%)	620.3 (3.7%)	1,191.1 (4.1%)	2,580.2 (5.0%)	4,848.2 (5.6%)	4,816.6 (6.5%)	14,651.9 (5.4%)
A	35.0 (1.9%)	260.4 (4.5%)	297.5 (5.0%)	889.0 (5.3%)	1,720.8 (5.9%)	3,291.0 (6.4%)	4,924.6 (5.7%)	4,504.6 (6.0%)	15,922.7 (5.9%)
BBB	58.0 (3.2%)	122.6 (2.1%)	252.5 (4.2%)	670.0 (4.0%)	1,478.7 (5.1%)	2,552.7 (5.0%)	4,389.3 (5.1%)	3,658.8 (4.9%)	13,182.5 (4.9%)
BB	13.0 (0.7%)	173.0 (3.0%)	119.9 (2.0%)	236.8 (1.4%)	370.8 (1.3%)	772.8 (1.5%)	2,369.9 (2.7%)	2,329.6 (3.1%)	6,385.8 (2.4%)
B	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	10.0 (0.0%)	15.0 (0.0%)	58.0 (0.1%)	111.6 (0.2%)	194.7 (0.1%)
NR	420.7 (22.9%)	560.2 (9.7%)	576.0 (9.7%)	1,933.9 (11.6%)	3,567.5 (12.2%)	5,633.4 (11.0%)	9,020.2 (10.4%)	7,816.3 (10.5%)	29,528.2 (10.9%)
Total	1,839.7 (100.0%)	5,792.6 (100.0%)	5,954.7 (100.0%)	16,666.1 (100.0%)	29,137.8 (100.0%)	51,138.8 (100.0%)	86,572.9 (100.0%)	74,521.5 (100.0%)	271,624 (100%)

Table 5: Deal Structure

	CDOs with tranche:		Tranche amount as a % of the par value of the CDO:						
Rating	**N**	**%**	**Mean**	**SD**	**p10**	**p25**	**Median**	**p75**	**p90**
AAA	530	100%	71.4	7.3	63.7	68.2	73.0	75.4	77.4
AA+	4	0.8%	5.4	2.7	2.6	3.3	5.1	7.5	8.9
AA	427	80%	6.5	3.8	3.7	4.7	6.0	7.7	9.1
AA-	9	2%	11.5	4.8	5.6	8.5	10.1	14.0	10.6
A+	17	3%	5.4	2.6	2.4	3.2	5	6.8	9
A	425	80%	6.3	3.8	4.5	5	5.8	6.6	8.4
A-	65	12%	6.6	2.2	4.4	4.9	6.7	8.5	9.1
BBB+	8	2%	3.3	3.4	0	1.3	2.2	4.2	10.9
BBB	411	77%	5	1.7	3.3	3.9	4.6	5.8	7.1
BBB-	97	18%	5.2	2	2.6	4.1	5.5	6.3	7
BB+	9	2%	1.4	1.1	0	0.6	1.6	2.5	3.1
BB	304	57%	3.2	0.9	2.1	2.7	3.2	3.8	4.3
BB-	69	13%	3.8	1.5	2.3	3.0	3.8	4.3	5.2
B+	0	0%							
B	10	2%	1.8	0.3	1.4	1.7	1.9	2	2.2
B-	3	0.6%	1.1	0.6	0.5	0.5	1	1.8	1.8
NR	524	99%	10.3	6.1	7.3	7.8	8.8	10.5	14.0

Table 6: Uniformity of Deal Structures

This table summarizes the liability structures observed for CLOs in our sample. Panel A shows that most CLOs have one of four combinations of rated tranches. Panel B examines whether liability structure is correlated with underlying collateral quality.

Panel A: Commonly Observed Deal Structures

	Number (CDOs)	%	Contains tranches rated:
Type 1	209	40%	AAA, AA, A, BBB, BB, NR
Type 2	69	13%	AAA, AA, A, BBB, NR
Type 3	38	7%	AAA, AA, A, BBB- , BB- , NR
Type 4	20	4%	AAA, A, BBB, BB, NR
Other*	197	37%	
All CDOs	**531**	**100%**	

*Each structure in this category appears less frequently than Type 4

Table 6, continued

Panel B: Asset & liability structures of four major deal types

Collateral quality frequency (when available)				
	Type 1	**Type 2**	**Type 3**	**Type 4**
BBB-	1			
BB+	1			
BB	1			
BB-	8	5		2
B+	153	49	19	18
B	38	10	18	
B-	5	3		
Total	**207**	**67**	**37**	**20**
Liabilities: Rated tranches as % of deal par				
	Type 1	**Type 2**	**Type 3**	**Type 4**
% AAA				
Median	73.1	74.3	66.8	76.1
Mean	71.9	70.1	66.7	75.6
SD	4.2	10.8	3.5	2.2
% NR				
Median	8	9.3	10	8.4
Mean	8.6	11.9	10	9.1
SD	2.2	9.9	1.1	1.9
% AA				
Median	5.7	5.1	8	
Mean	6	5.5	7.8	
SD	1.9	2.2	1.5	
%A				
Median	5.4	5.7	6	8.2
Mean	5.6	6.2	5.9	8.1
SD	1.2	2.3	1.1	1.4
%BBB				
Median	4.3	6.3		4.3
Mean	4.6	6.3		4.1
SD	1.3	1.7		0.8
%BBB-				
Median			6	
Mean			6	
SD			0.9	
%BB				
Median	3.2			3.1
Mean	3.3			3.2
SD	0.9			0.5
%BB-				
Median			3.6	
Mean			3.6	
SD			1.0	

Table 7: Collateral Restrictions

This table examines the frequency of collateral restrictions across CLOs, and the value of the restriction conditional on observing it. Most CLOs are revolving pools where the manager can turnover a fraction of assets each year, but the portfolio composition is governed by collateral restrictions decided upon at the time of issuance.

	CDOs with restriction		Conditional Distribution Statistics						
	N	%	Mean	SD	10th %	25th %	Median	75th %	90th %
MIN senior secured loans	355	67%	86.8	7.4	80	85	90	90	95
MIN senior loans	58	11%	84.3	10.1	75	80	85	90	95
MAX second lien loans	244	46%	11.7	10.1	5	10	10	12.5	15
MAX high-yield bonds	144	27%	6.9	4.4	5	5	5	10	15
MAX corp. bonds	25	5%	7.7	5.5	5	5	5	10	10
MAX structured fin securities	307	58%	5.1	3.9	3	3	5	5	7.5
Near default securities:									
MAX current pay	223	42%	6.0	2.2	5	5	5	7.5	7.5
MAX rated CCC+ or lower	309	58%	8.9	9.5	5	5	7.5	7.5	15
MAX debtor-in-possession loans	359	68%	6.7	3.5	5	5	5	7.5	10
MAX discounted obligations	115	22%	7.0	2.4	5	5	7.5	8	10
MAX obt. in bankruptcy exch.	14	3%	4.1	2.3	2	2	5	5	5
Collateral interest type:									
MIN floating rate	197	37%	92.8	8.1	85	90	95	95	100
MAX fixed rate	322	61%	8.1	9.4	3	5	5	8	15
Payment frequency of collateral:									
MAX paying less than quarterly	275	52%	9.1	5.1	5	5	10	10	15
MAX paying less than semiannual.	158	30%	6.3	3.6	5	5	5	5	10
MAX pay-in-kind	254	48%	5.3	3.6	2.5	5	5	5	5
MAX zero coupon	164	31%	4.2	1.5	2	2.5	5	5	5
MAX maturing after CDO	242	46%	2.6	1.3	2	2	2.5	3	4
Diversification:									
MAX conc. in single issuer	356	67%	2.2	1.0	1.5	1.6	2	2.5	3
MAX conc. in top 3 issuers, each	36	7%	2.9	1.2	2	2	2.5	3	5
MAX conc. in single industry	133	25%	8.9	2.2	8	8	8	8	10
MAX conc. in top 2 ind., each	37	7%	11.6	4.2	10	10	10	12	14
MAX conc. in top 3 ind., each	54	10%	13.0	7.3	10	10	12	12	12
Domicile of obligors:									
MAX non-US	257	63%	16.9	5.0	10	15	20	20	25
MAX non-US/UK/Canada	62	15%	10.5	6.3	3	5	10	15	17.5
Currency of obligations:									
MAX non-US dollar	21	5%	6.4	6.4	0	0	5	10	15
MAX non-Euro	111	88%	28.0	10.2	19.5	25	30	30	35
Rated by:									
MIN rated by S&P	19	4%	86.1	9.5	80	85	90	90	90
MAX rated by other agency	37	7%	10.0	2.4	10	10	10	10	10

Table 8: Level of portfolio defaults that rated tranches must/can withstand in rating agency simulation model

Scenario default rate = level of portfolio defaults that a tranche *should be able to* withstand (paying timely interest and ultimate principal by maturity) in cash-flow simulations; it is equal to the level of defaults in the collateral pool that has no greater than x% chance of being exceeded, where x% is the historical default rate on a corporate bond of the same rating and maturity as the tranche in question. *Break-even default rate* = level of portfolio defaults that a tranche *can* withstand, according to underwriter cash-flow simulations

		Scenario Default Rate						Breakeven Default Rate					
Rating	**N(tranches)**	**N**	**Mean**	**SD**	**P25**	**Median**	**P75**	**N**	**Mean**	**SD**	**P25**	**Median**	**P75**
AAA	1,082	903	44.1	9.1	37.1	40.6	51.9	762	51.9	11.7	43.2	48.5	59.2
AA+	4	3	43.4	12.4	30.8	44.0	55.5	3	48.1	12.6	36.5	46.3	61.5
AA	458	403	40.5	9.3	32.8	36.9	49.0	333	47.1	10.5	39.3	43.5	55.0
AA-	13	10	32.5	4.1	27.7	32.5	36.0	3	41.0	6.0	34.0	44.5	44.5
A+	21	21	29.6	3.1	27.4	29.6	31.4	18	36.3	6.0	31.1	36.0	40.0
A	472	418	36.0	9.4	28.9	32.0	45.1	361	39.6	9.5	32.9	35.7	47.7
A-	83	74	30.4	6.6	26.3	29.1	32.2	48	33.4	5.6	29.5	31.4	35.6
BBB+	10	6	29.0	7.0	23.3	28.1	28.9	6	33.5	7.5	29.4	29.4	36.0
BBB	507	448	29.4	8.3	24.3	26.2	32.5	402	31.9	8.8	26.4	28.2	35.7
BBB-	108	88	31.7	7.8	25.4	30.5	35.1	44	32.8	8.7	26.8	28.3	40.4
BB+	12	6	22.1	2.8	20.7	22.0	23	4	28.3	2.4	26.8	28.1	29.9
BB	345	307	24.3	8.5	18.5	20.3	27.2	278	27.9	8.3	22.3	24.1	34.7
BB-	82	59	26.9	8.7	20.4	24.2	37.0	12	29.4	8.5	22.8	27.1	34.8
B+	0												
B	10	5	28.7	8.4	20.7	34.2	34.9	3	29.5	7.0	21.8	31.1	35.6
B-	3	3	22.0	9.4	16.0	17.1	32.9	3	30.4	9.6	24.7	24.9	41.5
Total	**3,210**												

Table 9: Collateral Performance

This table summarizes the portfolio allocation of all CLOs rated by S&P that were outstanding as of January 2009.

	2007 Vintage CLOs			**2006 Vintage CLOs**			**2005 Vintage CLOs**			**2004 Vintage CLOs**			**2003 Vintage CLOs**		
	Portfolio Allocation as of:			Portfolio Allocation as of:			Portfolio Allocation as of:			Portfolio Allocation as of:			Portfolio Allocation as of:		
	Jan 08	Dec 08	Chg	Jan 08	Dec 08	Chg	Jan 08	Dec 08	Chg	Jan 08	Dec 08	Chg	Jan 08	Dec 08	Chg
%AAA	0.00	0.07	0.07	0.00	0.06	0.06	0.01	0.06	0.05	0.01	0.03	0.02	0.00	0.07	0.07
%AA	0.02	0.20	0.18	0.07	0.13	0.06	0.08	0.18	0.10	0.13	0.19	0.06	0.03	0.14	0.11
%A	0.41	0.64	0.23	0.19	0.54	0.35	0.35	0.64	0.29	0.18	0.44	0.26	0.05	0.23	0.18
%BBB	2.25	2.97	0.72	1.80	2.50	0.70	1.42	2.46	1.04	1.52	2.40	0.88	1.14	2.32	1.18
%BB	20.2	18.1	-2.11	22.8	19.9	-2.87	23.0	19.9	-3.11	22.7	20.7	-2.02	20.9	18.8	-2.08
%B	70.6	68.8	-1.79	69.1	66.3	-2.78	69.2	66.7	-2.64	65.2	63.7	-1.57	67.4	64.6	-2.79
%CCC	5.78	6.60	0.82	5.13	7.97	2.84	5.02	7.41	2.39	8.51	9.40	0.89	7.92	10.8	2.83
%CC	0.06	0.80	0.74	0.14	0.56	0.42	0.11	0.56	0.45	0.36	0.44	0.08	0.32	0.38	0.06
%D	0.72	1.88	1.16	0.73	1.95	1.22	0.68	2.11	1.43	1.29	2.67	1.38	2.30	2.73	0.43
Total	100	100		100	100		100	100		100	100		100	100	

Source: Standard & Poor's, "CLO Performance Index Report: January 2009".