Industry Study Securitizations

Dominion Bond Rating Service Limited

CDO Methodology

JUNE 2004

MARK ADAMS

MANROOP JHOOTY

JIREH WONG

Table of Contents

Introduction

The collateralized debt obligation and collateralized loan obligation markets (collectively "CDO" markets) continue to grow and evolve. Recent market evolution has been guided by: (1) dealers looking for ways to remain profitable as corporate credit spreads have become tighter; and (2) investors seeking to mitigate the pronounced migration risks of CDO structures through the use of asset-backed securities (ABS) as Reference Obligations, as well as through the use of other risk mitigants. Structural innovations have also been influenced (and limited) by the ability of dealers to hedge their own risks in these transactions.

With the trend towards multi-level CDO structures (CDOs of CDOs or "squared" and "cubed" structures), the use of ABS as Reference Obligations, the increased employment of option technology, and the development of unique transaction features, rating agencies have had to adjust their methodologies accordingly to evaluate individual structures. In particular, methodological approaches have become increasingly important since small changes in the structuring of multi-level CDOs can have a large impact on enhancement levels.

Apart from taking into account actuarial default probabilities, correlations, and recovery values, modelling techniques must now also capture the pronounced structural leverage and name repetition in the newer CDO structures. The advent of structural leverage and name repetition in multi-level structures has also led DBRS to look more closely at the issue of ratings stability. Apart from the typical analytical process, DBRS believes that buyers and rating agencies alike should be considering the sensitivity of the structure to migration risk. This is not to say that migration risk was not an issue before. Rather, the point is that these newer structures are potentially far more sensitive to credit deterioration. As part of any analysis, investors should understand and be comfortable with the sensitivity of a particular CDO tranche to rating migration, whether in a normal or a more stressed credit cycle.

With the increased importance of the modelling approach, and the increased sensitivity of investment bank profits to modelling results, this methodology outlines DBRS's approach to CDO products and the primary drivers of the credit risk modelling exercise. While this document is unable to discuss all the different types of products and issues involved in CDOs, the methodology will cover general modelling issues for single-level and multi-level CDO structures. The initial sections of this methodology focus on the key factors and their influence on the modelling process, while the subsequent sections focus on the application of these concepts to single-level and multi-level structures. Case studies are presented in the Appendices highlighting a typical single-level CDO transaction and a typical multi-level or squared CDO transaction.

Review of Basic CDO Structures

Generally, in structuring a CDO, there is an attempt to create a particular risk profile for the credit protection seller. The choice of risk profile will involve choices that include diversification, weighted-average rating factor (WARF), credit rating profile, actual versus synthetic instruments, and attachment and detachment points to create one or more tranches in a capital structure. These choices allow one or more investors to participate in CDO transactions according to their desired risk/return preferences.

As the CDO market has evolved, there have been several widely accepted structures that have been employed to accomplish these objectives, each with their own unique characteristics and nuances.

Cash Flow CDO Structures

The cash flow CDO structure typifies the quintessential CDO transaction and was a widely used technology during the early days of the CDO asset class. This structure captures the essence of a CDO transaction in its purest form as it involves the physical purchasing and holding of credit instruments (bonds, loans, credit derivatives, and the like) within the structure for the benefit of investors, while offering credit protection to the seller of those instruments. Yield generated from the instruments is used to fund the distribution of premiums due to each class of investor, while credit enhancement is provided mainly by subordination within the structure (i.e. the sequential pay nature of the various classes for both interest and principal payments), interest spread, and external enhancement in some cases.

Since physical instruments are purchased in such structures, credit protection sellers (investors) are exposed to certain risks that are above and beyond the credit risk of the pool. These additional risks include: (1) duration mismatch risk – resulting from instruments having maturities not necessarily matching the tenure of the transaction; (2) re-investment risk – as instruments mature, there may be risk that suitable investments of similar quality and suitable price are simply not available, thereby possibly resulting in a period of reduced earning potential for the pool; (3) related to re-investment risk are ramp-up and wind-down risks where, again, the ability to ramp up the pool or the ability to wind down the pool may be affected by certain market and availability factors; (4) market value risk of the underlying instruments themselves – depending on whether structural features in the transaction permit or require the trading or selling of instruments at certain triggers, or simply as a result of having to re-invest due to maturity of those instruments, the instruments are not transacted at par, thereby crystallizing a loss for investors. Market risk can also arise as a function of attempting to dispose of the securities at the end of the transaction through an auction procedure; and (5) timing risk that can arise in a variety of ways. Timing risk can relate to negative carry on the transaction for the time it takes to recover on a defaulted security. Timing risk can also arise since, at the end of the transaction, if a security has not matured, it needs to be sold. The ability to sell, and the timing of the sale, will depend on the transaction rules as to when, and at what price, securities can be sold. As a credit protection seller or investor it is important to keep these "side effects" in mind when dealing with cash flow CDO structures and to ensure that appropriate mitigants are considered in dealing with these non-credit risks.

In addition to these above complexities, many of these transactions are typically not standardized and important differences can arise between different cash-flow transactions. Transactions can feature different rules for major structural features, including: (1) eligibility criteria on initial investment and on replenishment; (2) the use of different triggers for interest coverage and collateral coverage levels; (3) different rules for the priority of payments for different instruments in the capital structure; and (4) different procedures and rules for auctioning off the portfolio after a certain period of time has passed. These transactions can also be a little more complicated since true sale, assignment, and custodial issues may also have to be evaluated for a particular transaction.

Synthetic CDO Structures

To avoid some of the legal, market, and liquidity risks for cash flow CDOs, synthetic CDO structures were developed. Instead of transferring securities through a true sale, these transactions use synthetic transfers to minimize or eliminate legal risks involved in the transfer. In addition to the concept of a synthetic transfer, the ISDA credit derivatives definitions were used to determine the specific forms of credit (and market) risks that credit protection sellers were exposed to. Since their introduction in 1999, standardized credit event definitions have themselves undergone some evolution and adjustment to reduce market risks and focus more exclusively on credit risks.

With the advent of these two significant developments, the idea of a credit default swap that is more reflective of true credit risk and based on standard definitions, became possible. It did not take long before such credit default swaps evolved into swaps resembling a portfolio of Reference Obligations, the essence of a synthetic CDO structure.

As stated above, the synthetic CDO structure reduces the inefficiencies associated with physical instruments. In the synthetic context, since exposures are determined on a purely notional basis, it also becomes possible that the entire capital structure need not be fully funded for essentially the same reason, that it too can be notionally created. Effectively, this means that investors now have the opportunity to engage in these transactions at precisely the attachment and detachment points of their choosing for a particular tranche, without the need for a full capital structure. Stated differently, the credit enhancement available to such an investor, although still in the form of subordination, does not necessarily need to be funded, but rather only defined notionally.

As a further extension of the evolution of the synthetic CDO structure, it became possible to create a structure where tranches from other CDO structures (whether synthetic or otherwise) are themselves included as Reference Obligations within a greater overlying synthetic CDO structure. These structures are known as CDOs of CDOs or multi-level CDOs. With the introduction of these types of structures, additional complexities arose that are not seen in single-level CDO structures. As a result, a significant portion of this document will be devoted to the treatment of such structures and discussion of the salient considerations thereto.

Managed vs. Static

As it pertains to both synthetic and non-synthetic CDO transactions, the issue of management or lack thereof, does present some distinct and noteworthy considerations. In a managed transaction, the initial and ongoing selection of which credit instruments (non-synthetic) or Reference Obligations (synthetic) are included in the portfolio, is made by a paid, third-party manager. In the static case, however, the Reference Obligations or credit instruments are selected at the outset of the transaction, usually by the sponsor with input from the investor(s) and do not change during the life of the transaction. Different considerations need to be kept in mind for managed versus static transactions.

In the static case, all parties are cognizant of the specific credit instruments or Reference Obligations that form the Reference Portfolio. Often, the credit protection seller (investor) has significant input into which names are included in the initial portfolio and benefits from the negotiation process that is hallmark to bespoke CDO transactions. Although in the view of the investor, there is no risk that, within the life of the transaction, certain credits can be switched for certain other credits of lower quality, the flipside is true in that there is also not the benefit of that same ability to switch credits for the sake of maintaining or improving the performance or risk profile of the underlying portfolio. As the lack of intervening control is removed from the transaction, additional emphasis is placed on the initial selection process.

In the managed case, the opposite is true since there exists a paid, third-party manager. In this case, certain issues come to light requiring further consideration as outlined below:

<u>Competency</u>

A basic issue in evaluating any manager is whether or not the manager is competent to manage a particular transaction. Time must be taken to understand the skill and capacity of a manager in understanding and evaluating credit and other risks in particular market sectors. The skill and competency of a manager is a function of the human capital available to that particular manager. There is an obvious preference for a depth of talent and experience that is spread among a number of individuals. This reduces the risk of reliance on a limited number of individuals. Attention should also be paid to the ability of the manager to continue to attract and retain talent over time. The ability of a manager to attract and retain talent helps in ensuring the application of consistent expertise through the life of the transaction.

In addition to competency, the relative skill level of the manager and associated performance benchmarks are reviewed. However, there are a number of difficulties in using performance benchmarks for CDO managers. First, and most obviously, most managers have a short track record. Second, and particularly with a short track record, statistical comparison is not meaningful. Apart from this, many of the questions that arise for any type of benchmarking activity also apply, including the issue of what is a proper benchmark or benchmark portfolio for comparison.

Alignment of Interests

A fundamental issue in these structures is whether or not the manager is aligned with investors. In earlier CDO transactions, it could be argued that this alignment of interests was lacking and that managers attempted to arbitrage structural rules meant to protect investors. This led to some concern among rating agencies that managers, particularly when the portfolio was deteriorating, could compound rather than help avoid risks and problems.

One of the problems that can be encountered with the issue of alignment of interests is that, with a full capital structure, investors may have very different interests in the portfolio selection and management process. Because of different interests and risk tolerances among the various investors in a full capital structure, it is difficult to analyze whether the manager's interests are aligned, or with whom they are aligned. In contrast, and in a synthetic deal with a single tranche, alignment is easier to analyze and achieve.

In examining the issue of alignment, DBRS looks at a variety of issues, including: (1) what is the priority of the manager to cash flows in the transaction?; (2) does the manager hold equity or lower-rated notes in the transaction?; (3) is it possible for the manager to lose money (and how much)?; (4) if the manager holds equity or lower-rated notes, what ability exists to assign these instruments or pay off these instruments early in the course of the transaction?; (5) if portfolio deterioration occurs, what is the most likely response of the manager and will this help to protect investors?; (6) can the manager be replaced when the manager's financial interest in the transaction has been eliminated or impaired through portfolio performance?; and (7) in what situations would the manager act contrary to the interests of investors and how could this be accomplished?

Market Commitment

DBRS is also interested in attempting to understand what motivates a manager to enter a particular market and why the manager believes it will be able to continue in business in that particular market over time. Answers to this very general question can be quite informative. There is a great deal of value in understanding whether a manager has a commitment to stay in a particular market space over the longer term. Dangers can exist where a manager decides to vacate a particular part of the market, but the manager is still nonetheless responsible for managing a transaction that has not yet matured. It is also valuable to understand whether or not a manager is concerned about current and future performance and how these will impact the ability of the manager to obtain future business.

Any analysis of market commitment is subjective and there can be no assurances on the issue of manager commitment. Managers can and do change and may not be in place over the course of a particular transaction. Nonetheless, it is helpful to attempt to gain insight into whether a manager may potentially add value over the longer term. At the same time, and if the transaction is structured to incent conservative behaviour, the structural features of the transaction can go a long way to help self-select a new manager that will act in a manner consistent with investor interests.

Fundamental Modelling Assumptions

In the evaluation of credit portfolios, it is important to keep in mind several key factors that are fundamental to credit derivatives in general.

No Upside

Investors in CDO products are basically selling a credit protection option to the credit protection buyer for a specific time period. The protection buyer makes payments of an agreed upon spread (in ISDA swap terminology, the "fixed" rate payments) while the credit protection seller provides the "floating" rate payments by way of whatever loss settlements are required from the protection seller, as defined in the transaction, should they occur. If the transaction is collateralized, the credit protection seller will also receive the yield from the collateralized amount (which is invested in permitted investments). In this arrangement, the best possible result for the credit protection seller is that, over the life of the transaction, it receives the full premium without any defaults causing either direct losses or reductions in the market value of the CDO tranche.

Ultimately, the investor has to focus on the risk/return reward of selling credit protection. Certainly, and as fixed income yields have decreased, selling credit protection appears to be a more attractive activity for institutional investors. In this respect, however, investors that sell credit protection must thoroughly examine the probability that they may suffer losses, compared to the enhancement in yield that they receive through selling credit protection.

In DBRS's view, and in arriving at the probability of loss, it is wise to take a conservative view of the stochastic factors that impact this analysis. DBRS takes this view for several reasons. Firstly, ratings have an actuarial profile and tend to reflect a long-run view. On the other hand, a particular CDO pool is subject to the credit cycle over the life of the transaction, which may or may not coincide with long-term, actuarial performance. At least from DBRS's perspective, investors should be concerned that a particular credit cycle will be more severe and should look for enhancement levels that are commensurate with the investor's desired level of risk, in order to mitigate the prospect of credit deterioration that is more severe than the actuarial average. Secondly, and apart from the probability of default for Reference Obligations, any pool evaluation will also feature estimates of recovery levels and correlation factors. Recovery levels have a wide variance and correlation factors can change over time. While these risks are common to CDO transactions, different methodologies for setting enhancement can be more or less responsive to these types of risks. Investors should understand, and be comfortable with, how different rating agencies evaluate these risks.

Arbitrage

Many transactions are structured to take advantage of potential market arbitrage opportunities. Arbitrage can occur on many levels, including: (1) the difference between credit spreads and credit ratings; (2) industry classifications; and (3) the credit risk models themselves. DBRS attempts to be mindful of these different potential arbitrages in the evaluation of CDO pools. While DBRS expects that arbitrage will exist between credit spreads and credit ratings (since spreads take into account short-term and long-term information whereas ratings are applied through the business cycle), DBRS remains concerned that the rating inputs are up-to-date and are reflective of longer-term credit risk. As a result, if a DBRS rating is unavailable for a Reference Obligation, DBRS will take the lowest available rating from another major rating agency (and also take into account whether the Reference Obligation is under watch or outlook). DBRS includes Moody's, S&P, and Fitch in the category of major rating agencies for this analysis. The purpose of this procedure is not to eliminate the arbitrage, but rather to take a conservative view of credit quality. As will be seen in this methodology DBRS does focus on applying conservative standards and assumptions to protect investors from being arbitraged in a highly-levered, complex, and difficult asset class.

The point with respect to conservatism deserves some explanation. Since many modelling variables are stochastic, and CDO transactions often feature leverage, DBRS believes the purpose of credit risk modelling should not be to establish the precise attachment point for a particular rating. In fact, using actuarial models to capture stochastic processes is ultimately a self-defeating exercise, as it does not provide insight into the random nature and variability of the outcomes. In reviewing the modelling inputs (ratings, actuarial default curves, correlations, recovery assumptions, and documentation features), it is clear that all of the major variables are random, stochastic variables. In using an actuarial approach, the only way to protect investors against stochastic risk is to take a conservative view on such variables. Nonetheless, the level of conservatism should be commensurate with the desired rating level. DBRS believes this approach best serves the investor community since it helps to mitigate the risk that the upcoming credit cycle will diverge from the long-run actuarial credit cycle upon which modelling is generally based. Taking these factors into account, the concept of "precision" does not necessarily apply as actuarial tools are being used to measure stochastic risk over a short, fixed period of time.

Leverage and Inherent Rating Volatility

CDOs have always involved a high degree of leverage. Leverage translates to more credit migration risk and uncertainty compared with other rated products. With recent structural innovations and the movement to multi-level structures with name repetition, leverage concerns have been exacerbated. While leverage is taken into account in initially setting enhancement, there is some concern that the rating is not directly responsive to the risk of credit migration in the transaction, particularly in the multi-level transactions. To help mitigate this concern, and apart from using conservative default curves, DBRS takes a Negative trend and/or "Under Review with Negative Implications" status into account for rating purposes. DBRS will also look at running simulations over the initial life of the transaction from a default and credit migration perspective to determine how susceptible the transaction is to initial term migration risk. DBRS believes this information is valuable to investors that are attempting to understand the risk/return trade-offs between one CDO transaction and the next.

Investor Suitability

In carrying out the modelling process, DBRS does not distinguish between different types of investors. At the same time, however, it must be recognized that different investors have different capabilities in dealing with the issue of credit migration and portfolio deterioration. This is an issue of particular importance for ABCP Vehicle investors since, at a certain point, ABCP Vehicles will be unable to finance a particular tranche.

There are three strategies available to deal with this risk for an ABCP Vehicle. The first strategy is to buy tranches with reduced risk levels in transactions that are conservatively structured. The active purchaser should be sufficiently sophisticated to understand that different transactions have significantly different credit migration risks, depending on how the transaction is structured. In multi-level structures, for example, these purchasers will look at name overlap (and the credit ratings and correlations of those overlapped names), the leverage between the different levels in the multi-level structure, the size of the CDO portion in the transaction, the attachment and detachment point of the underlying CDOs, and more generally where the spread and profit in the transaction are generated. In this respect, the source of profit in these transactions for the dealer is also often the source of risk for investors. By looking at these aspects, purchasers can help to distinguish between transactions that, on the surface and from an initial ratings perspective but not a migration risk perspective, appear to be equivalent.

Apart from looking at conservatively structured transactions (and in this respect, not all transactions are equal), and as a second method of dealing with migration risk, these purchasers may look to attach above the AAA level. From the perspectives of default and migration risk, the incremental strength between the AAA and the Junior Super Senior levels is non-linear. For a relatively small reduction in premium payment, there is often a substantial reduction of credit risk. In addition, a Junior Super Senior tranche tends to exhibit lower loss severity given default.

The third and most useful strategy is disclosure. DBRS has been working to move ABCP Vehicle transactions to vehicles that disclose the identity of these transactions so that investors can see the transactions that have been completed. DBRS believes transparency and disclosure will assist in maintaining disciplined strategies for ABCP Vehicles that purchase these types of transactions. However, the propensity for greater transparency may not necessarily improve, unless market conditions and/or regulation create incentives to do so. In particular, compensatory market pricing for transparency could create the necessary incentives for market participants to increase the quantity and quality of disclosure.

MODELLING APPROACH

In the analysis of any CDO portfolio, the evaluation and understanding of the Reference Obligations is a primary focus. In the particular case of evaluating credit portfolios, this evaluation is distilled into the analysis of three basic factors: (1) the probability of default; (2) if such defaults occur, the loss severity that is expected to occur; and (3) the correlation assumptions between the Reference Obligations. Apart from these main drivers, this section will also generally comment on DBRS's approach to transactional features such as various forms of concentration, including obligor, geographic, and industry concentrations.

Default Probability

Default probability can be defined as the likelihood that an obligor may default on its obligations over a certain time horizon. The time-dependent nature of this parameter should be kept in mind considering that with increased tenures, average default probabilities trend upwards. This results from the fact that, in general, the credit quality of obligors tends to migrate downward, i.e. towards default, with the passage of time.

In terms of defining the default probability, two tasks must be completed. The first is to identify a rating or credit factor for each Reference Entity or Reference Obligation. Once a rating is established, the next step is to build a default curve to translate particular ratings into probabilities of default over a given time horizon. The first subsection will deal with different techniques for deriving ratings. The second subsection will discuss the derivation of default curves for particular time horizons.

Assigning a Rating

To quantify the probability of default, DBRS takes a ratings-based approach. This approach assigns probabilities of default to individual Reference Obligations based on the ratings of those entities. It follows that the assignment of the rating becomes critical in determining the ultimate probability of default. As a result, several methods are used to determine the appropriate Reference Obligation ratings:

Rating Estimate

Generally, DBRS will use its own rating for a corporate or securitized Reference Obligation. If a rating is not available from DBRS or from another major rating agency, DBRS may assign a "shadow" rating. A "shadow" rating is essentially equivalent to a standard rating, except that the rating is not published.

Other Rating Agencies

If DBRS does not rate a particular Reference Entity or Obligor, DBRS may rely on the ratings of other major rating agencies. In the process, however, DBRS may adjust these ratings to reflect what DBRS believes is the credit quality of the Reference Entity. This can occur where there is a significant variance between the other major rating agencies with respect to a Reference Entity (i.e. where there is a two or more notch difference in ratings). Apart from the above caveat, DBRS does not believe that automatically "notching" the ratings from other agencies serves any intrinsic analytical purpose. While DBRS may look at other ratings if a DBRS rating is not available, DBRS typically applies a methodology where the lowest agency rating is considered for each individual Reference Obligation. This approach attempts to minimize arbitrages between credit spreads and credit ratings, particularly where different rating agencies respond to events at different speeds and more notably apply different rating criteria.

In addition, whenever credits are placed on a Negative trend and/or placed "Under Review with Negative Implications" DBRS will apply a one-notch downgrade to that entity in order to determine the resultant rating. The rationale for this approach is to capture possible impending downgrade actions that would most likely occur over the near term of the transaction given that the particular credit is already under negative consideration at the outset. In effect, notching such credits up front builds in some insulation against potential migration of the rated tranches as a result of ratings migrations in the underlying collateral pool. Effectively, the pool is treated as if the potential downgrades have already occurred and hence higher resulting credit enhancement is required. By requiring higher enhancement, the portfolio will be better able to withstand deterioration both from a default perspective as well as a ratings migrations perspective. Although a one-notch downgrade may be insufficient in a multiple downgrade scenario, in general DBRS believes this is a reasonable stress to apply at the outset.

Apart from the NRSRO rating agencies, DBRS does not rely on specialized rating agencies (insurance, banking, or otherwise) or rating agencies domiciled in only one country due to the inability to do any comparative rating analysis between DBRS and the agency in question. DBRS reserves the right not to accept any individual rating notwithstanding our general reliance on a major rating agency in other situations/transactions.

Mapped Ratings

In certain transactions, primarily bank book-based CLO (collateralized loan obligations) transactions with a large number of unrated small to medium-sized Reference Obligations that are continually changing subject to eligibility criteria, the process of evaluating each loan separately is cumbersome, time-consuming, impractical, and expensive. Internal credit scores are typically assigned by major banking institutions to such loans. A mapping of these internal credit scores to equivalent DBRS ratings may be accomplished, provided a number of conditions are satisfied. In particular, a certain level of jointly rated obligors is necessary to determine the level of correlation between the internal rating scale and DBRS's scale. Unless a reasonably high level of correlation is found, no mapping of ratings is permitted. When mappings are allowed, DBRS does not review individual obligors included in the collateral pool. However, the mapping process will be periodically updated to capture divergences and changes in the internal bank rating process. Notwithstanding these efforts, experience has shown that the mapped rating process is generally inferior to a more comprehensive credit analysis process.

Other Approaches

The evaluation of large collateral pools is a daunting task and where appropriate, DBRS will work with the sponsor of the CDO to develop other alternative approaches to produce rating equivalent evaluations of default frequency. Failing this, DBRS will generally make the assumption that an obligor will fall into the lowest non-default rating category used for CDO transactions (i.e. < CCC).

<u>Default Curve Analysis</u>

Once a suitable rating is assigned to each and every obligation in the portfolio, the task switches to that of assigning probabilities of default to those rating categories. In examining default patterns, a number of points should be kept in mind. For instance, default rates increase as the credit quality of the obligor declines. Default probabilities increase in a non-linear manner, particularly below the BBB (low) point. Since this is the case, it is important to avoid the application of straight averages in examining the credit quality of a pool. Instead, DBRS will look to the WARF in evaluating credit portfolios. The WARF is calculated on the aggregate portfolio based on individual entity ratings and is weighted by the Reference Obligation notional amounts as well as the rating factor applicable to the entities' ratings.

$$\text{WARF} = \frac{\sum_{i=1}^{n} (LoanAmount_i * RatingFactor_i)}{\sum_{i=1}^{n} LoanAmount_i}$$

The aggregate WARF of the pool provides an indication as to pool quality as a whole. Nonetheless, the WARF does not tell the complete story. Since it is after all, an average, it does not necessarily capture the distribution of ratings throughout the portfolio. It is possible that two different rating distributions could result in the same WARF, but require different credit enhancements e.g. a bimodal distribution obviously behaves differently from a distribution of ratings that is more centred on the average.

Another important factor to keep in mind regarding defaults is that default probabilities increase with time. This follows from the fact that credit migrations tend to be skewed downward. All else being equal, the longer the time horizon for exposure, the more enhancement that is required.

While the time generalization point is an important one, it is not always necessarily true. This leads to a further point. Defaults occur unevenly through time and tend to be highly correlated with economic stress and other macroeconomic variables. As a result, it does not necessarily always follow that short-term assets will default at a lower rate than long-term assets. More generally, and in constructing default curves, DBRS is sensitive to the fact that annualized default rates exhibit tremendous differences depending on the time in the economic cycle.

In constructing a default curve, it is important to compare the default rates used to these stressful periods to ensure that the default curve is sufficiently stressful to capture these environments if and when stress conditions reoccur. In this respect, the construction of a default curve is an exercise of judgment. The default curves shown below have been constructed with these considerations in mind. As a result, the curves shown may not exactly track those of historical experience but rather exhibit general trends reflective of adjustments for noise and factors mentioned above. The basis of these default assumptions originates from historical default rates as published in various studies covering several decades of observation (primarily U.S.). These curves serve as the basis for the simulation modelling approach conducted by DBRS in the analysis of any CDO transaction.

Table 1: DBRS Default Curves

Obligor Rating	Five-Year Default Probability	Ten-Year Default Probability	DBRS Rating Factor
AAA	0.38%	1.29%	1
AA (high)	0.44%	1.55%	10
AA	0.55%	1.89%	20
AA (low)	0.69%	2.40%	40
A (high)	1.06%	3.39%	60
A	1.26%	4.04%	85
A (low)	1.48%	4.87%	135
BBB (high)	2.06%	6.48%	200
BBB	2.77%	8.51%	300
BBB (low)	4.15%	12.00%	525
BB (high)	6.98%	18.18%	900
BB	11.09%	26.10%	1,450
BB (low)	15.55%	34.19%	1,900
B (high)	20.21%	42.34%	2,350
B	31.14%	54.96%	2,950
B (low)	52.28%	70.92%	3,675

For selected credit exposure tenure, probabilities of default are then assigned to each individual Reference Obligation based on the above table. Because of the technique used in arriving at these probabilities, each value represents the expected default probability for an asset for a particular rating category for the chosen tenure. Note that the above values only represent the expected default numbers. For an investment-grade CDO, however, the modelling has to take both expected and unexpected defaults into account.

To capture unexpected defaults, and to account for the variation of actual default experience from long-run average default probabilities, DBRS employs a Monte Carlo simulation approach. By simulating the probability of default for each Reference Obligation, and taking into account other factors mentioned in this paper, including recovery rates and correlation, a distribution of losses can be generated. The distribution will cover the expected and unexpected losses from the pool. Credit enhancement levels are set at levels consistent with coverage of unexpected loss levels for a particular rating category. For example, the above table shows that for AA-rated debt obligations, the average default probability over a five-year term is 0.55%. Therefore, in order to achieve a AA rating on the aggregate portfolio for a five-year exposure, the level of credit enhancement will be chosen such that 99.45% of all loss outcomes need to be covered off by the offered enhancement.

In addition to the values in the above table, DBRS will apply additional adjustments to these default probabilities to reflect other characteristics of the pool. For example, the level of mismatch between credit event definitions in comparison to the definitions used in arriving at historical default probabilities must be taken into account in establishing probabilities of default. To the extent the definitions are not matched, a slight "gross-up" will be applied to historical averages to account for potentially higher credit event exposure. A good example of this can occur where credit events in ISDA documentation, such as "Restructuring", depart from what would otherwise be considered an actuarial default. Fortunately, recent changes to the "Restructuring" definition have helped to lessen the importance of this issue somewhat. Also, "Bankruptcy" and "Failure to Pay" are now closely matched to actuarial defaults for purposes of the ISDA 2003 Credit Derivative Definitions.

Default Timing

Before leaving the topic of default, it is worthwhile to mention the issue of default timing. In the case of a synthetic transaction, the timing of defaults can play a role in whether or not particular tranches will need to be downgraded. This is particularly the case at the outset where a transaction is most sensitive to credit migration risk. It is important to note that, since credit migration tends to be downward, there is an inherent assumption in the actuarial modelling that the absolute credit strength of a pool can deteriorate over time while the rating does not need to change. The issue is, however, whether or not defaults and/or deteriorations are occurring faster than the actuarial migration rates used in the modelling.

Apart from issues of expected versus actual migration, default timing also plays an important role in cash flow transactions since it can lead to the triggering of interest rate or collateral coverage triggers or where there can be negative carry from the time of a default until an ultimate recovery. Since default timing can affect a transaction, one has to decide on how timing should be dealt with. Assuming that all defaults occur in the first year would be unrealistic, while assuming that they occur evenly over the life of the transaction ignores the reality that defaults tend to be associated with economic cycles. The table below outlines DBRS's assumptions on the timing of defaults as used in DBRS stress models (utilizing the underlying obligor credit rating). The logic underlying this table basically assumes that a CDO transaction was completed just before an economic recession equal to the worst in the past 20 to 30 years.

Table 2: Default Timing Assumptions

Year	If Obligor Rating is B (high) or Lower	If Obligor Rating is BB (low) or Higher
1	40%	25%
2	25%	25%
3	25%	20%
4	10%	15%
5		15%

The more complicated situation is where enhancement levels vary, depending on timing. This can occur where subordinate tranches pay out early under specified conditions. This is not uncommon to see in more complex cash flow structures. These features introduce significant optionality and increase the importance of timing issues in credit risk modelling. In these situations, DBRS's general assumption is that the timing of defaults happens at the worst possible time periods. This ensures that, if defaults happen at other times, the ratings will not be overly sensitive to the timing issue. In these situations, and compared to the more general assumptions above, DBRS will have a tendency to compress the timing assumptions into a shorter time period. This time period is generally a two-year to three-year window, depending on the circumstances.

Apart from varying timing, cash flow transactions also have to reflect the particular features of the transaction. These features could include conditional paydowns of subordinate tranches (depending on prior performance and/or timing), allocations of excess cash flow and interest, any optionality in the waterfall of payments, lock-up triggers, prepayments, and paydowns, etc. To accomplish this, DBRS has tended to either build a direct cash flow model of the transaction or to modify a dealer's cash flow model. Once the cash flow model incorporates all of the features of the transaction, DBRS will attach a default simulation to the cash flow model (which encompasses probability of default, recovery assumptions (including timing) and correlation factors). DBRS will then iteratively look at how the cash flow features of the transaction interact with the simulation to understand how overall transactional features impact loss levels, including the timing of default. After identifying these features, DBRS will assume a combination of variables that is commensurate to the desired rating in order to generate a loss distribution. Enhancement will then be established from this distribution for the ratings of various tranches.

Recovery Assumptions

The second major component needed to evaluate CDO transactions is recovery or loss severity assumptions. These assumptions directly determine the loss severity of an asset upon default and thus the quantum of credit enhancement necessary to cover this default.

Factors affecting levels of recovery include the nature of, and security over, the collateral or lack thereof. Not surprisingly, the type of collateral included in a CDO can have a significant impact. Recourse to a corporation is different from recourse to an ABS asset. Additionally, differences can occur depending on whether the form of the obligation takes the form of a bank loan or a bond. On average, bank loans consistently have better average recovery factors than bond obligations. Recovery values are also impacted by seniority structure. Differences can also exist depending on whether the obligation is senior, mezzanine, or subordinate.

The assumption that recoveries are higher for secured debt versus unsecured debt and higher for senior versus subordinate debt are well documented in empirical research[1]. The conclusion that bank loans exhibit better recoveries than bonds deserves some explanation. Bank loans should have higher recovery rates than comparable public bonds because the banks are usually more involved in the credit than public bondholders. This close relationship between banker and borrower usually entails tighter covenant structure, closer monitoring, and periodic compliance certificates. While the bank has the capability to perform this additional work, public bondholders do not have this capacity. Bank loans also benefit from monitoring and the ability to restructure the lending relationship. This is often very awkward for public bondholders. Also, because the borrower may benefit from the banking relationship in other ways, including other services or credit facilities, the bank may be able to negotiate more effectively than public bondholders. In general, such a position allows banks to act earlier than public bondholders, resulting in commensurate increases in recovery levels.

The general difference between bank debt versus bonds in terms of recoveries leads to an important point. That is, the recovery function can be heavily impacted by the quality of loan monitoring and servicing. If a transaction features a servicer, DBRS will take this into account in evaluating recovery levels. A review of the servicer's performance on past defaults will be the primary determinant of whether such benefit of higher recovery rates, within the specified range, will be given. In this respect, however, it is also important to note whether or not higher recoveries have been achieved through longer recovery periods. A longer time horizon associated with a workout period may indeed increase recovery rates (on a nominal basis) but consideration needs to be taken of the carrying costs for the period in question. In modelling a CDO, the higher recovery rate assumption may be offset wholly or partially by a longer recovery period.

[1] Caouette, Altman, Narayanan, *Managing Credit Risk*, John Wiley & Sons, Inc., Toronto, 1998, pp. 193-216.

Apart from the many factors that can impact recovery, one must also realize that, even if one factor that influences recovery is viewed in isolation, recovery values can exhibit a wide degree of variance. With the variety of factors that influence recovery and the variance of recovery values (which has been confirmed in numerous recovery studies)[2], the issue then becomes how to approach the modelling of recovery variables. In approaching this issue, one also has to remember that, in a particular CDO pool, given that there are relatively few defaults, one cannot expect that the Reference Entities that default will show average or expected recovery values. One can legitimately expect wide differences in recovery values for Reference Obligations that default.

Base assumptions for recovery values reflect DBRS's review of published material on defaulted loan and bond recovery rates, as well as ongoing data obtained from various lenders. Such base assumptions may be updated as more data, particularly loan loss data, becomes available. Based on empirical research, DBRS will generally use a range of recovery values for different factors that influence recovery, such as senior versus subordinate, secured versus unsecured and bank loan versus public bonds. In using a range of values, DBRS's strong preference will be to use recovery variables at the lower end of the respective ranges whenever AAA ratings are desired. This provides some comfort that the values used are appropriately conservative. Generally, DBRS will adjust recovery values, depending on the desired rating of the CDO tranche that DBRS is rating. DBRS's view is that the higher the rating of the tranche, the lower the recovery assumptions that should be used. Once again, the issue is not establishing precision for a stochastic variable but rather establishing an appropriate level of conservatism.

Table 3: Recovery Rate Assumptions

	Recovery Rates	
	Minimum	**Maximum**
Senior Secured Bank Loans	50%	70%
Senior Unsecured Banks Loans	40%	60%
Senior Secured Public Debt	40%	55%
Senior Unsecured Public Debt	30%	50%
Subordinated Public Debt	20%	30%
Other	0%	10%

Apart from setting recovery values, it is also important to keep in mind the timing of recovery. In this respect, there are large differences between synthetic transactions where the valuation and settlement procedure is set out in the legal documentation, compared to a cash transaction where actual recoveries may take place over a possible extended time period. Obviously, different types of recovery issues in synthetic and cash deals raise very different issues.

For synthetic transactions, the initial concern is whether the bid price is sufficiently liquid to attract the relevant bids at a fair market price. Apart from this, DBRS will be interested in ensuring that a specific time period passes before pricing is to be set. This concern follows since pricing becomes more certain and less volatile as more information about a default becomes available. From DBRS's perspective, there should be a minimum of 45 business days for pricing liquid corporate names. For ABS assets, or for assets that are not as liquid, DBRS strongly prefers to see longer periods for pricing. This allows more information to become available in establishing market pricing. Information is particularly critical where the security is not otherwise very liquid. Needless to say, while pricing may be more accurate as time passes, it does not mean to say that the pricing is correct or that greater or lesser recoveries could be realized with more time. Additionally, consideration has to be given to the cheapest to deliver option. The difficulty with this point is that it is extremely dependent on the Reference Entity. Due to the above issues, it is important to note that, in synthetic deals, recovery levels may deviate from the empirical studies since these studies were based on real securities where there was an opportunity to maximize recovery proceeds through longer workout processes.

Another issue that has arisen in the synthetic market is the potential use of fixed recovery assumptions. While fixed recovery levels do provide a greater degree of modelling certainty, they can have both beneficial and negative side effects. Certainly, for credit events such as "Bankruptcy" and "Failure to Pay", fixed recovery levels provide certainty. While the investor gives up recovery values above the fixed recovery values for these credit events, the investor is also protected from lower recovery levels. The extent of benefit derived from fixed recoveries will depend on the expected level of recovery, compared to where the recovery cap is set. On the other hand, for softer credit events that do not conform to an actuarial definition, the fixed recovery rate is not as necessarily beneficial for the investor. As an example, in a "Restructuring", it is possible that there may be market value risks with respect to a Reference Entity but not fundamental credit deterioration or default. Accordingly, recovery values may be much higher than other types of actuarial credit events. In these situations, and to the degree that Restructuring events occur, investors are likely giving away the upside on recovery values.

[2] Caouette, et al., Altman, Resti, Sironi, *Analyzing and Explaining Default Recovery Rates*, A Report Submitted to ISDA (http://www.isda.org), 2001.

Perhaps the solace for investors on this point is that only a minority of events tend to be “Restructurings” compared to “Bankruptcy” and “Failure to Pay”. In any case, for transactions where fixed recovery levels are offered, the determination of credit enhancement levels takes this feature into account. While issues of the asset types targeted and market liquidity may affect the recovery timing assumptions generally used by DBRS, significant recovery periods will almost always be the norm in cash-based transactions. The base AAA assumption is that recovery periods will be 24 months during which no cash flows are received on the defaulted securities. Lower-rated tranches may use slightly lower recovery periods, but DBRS is unlikely to ever assume recovery periods of less than 18 months. For liquid bonds, recovery periods of 12 months may be used as it is assumed that the bonds will be sold during that time frame, rather than held awaiting ultimate recovery of proceeds from liquidation of the obligor or collateral.

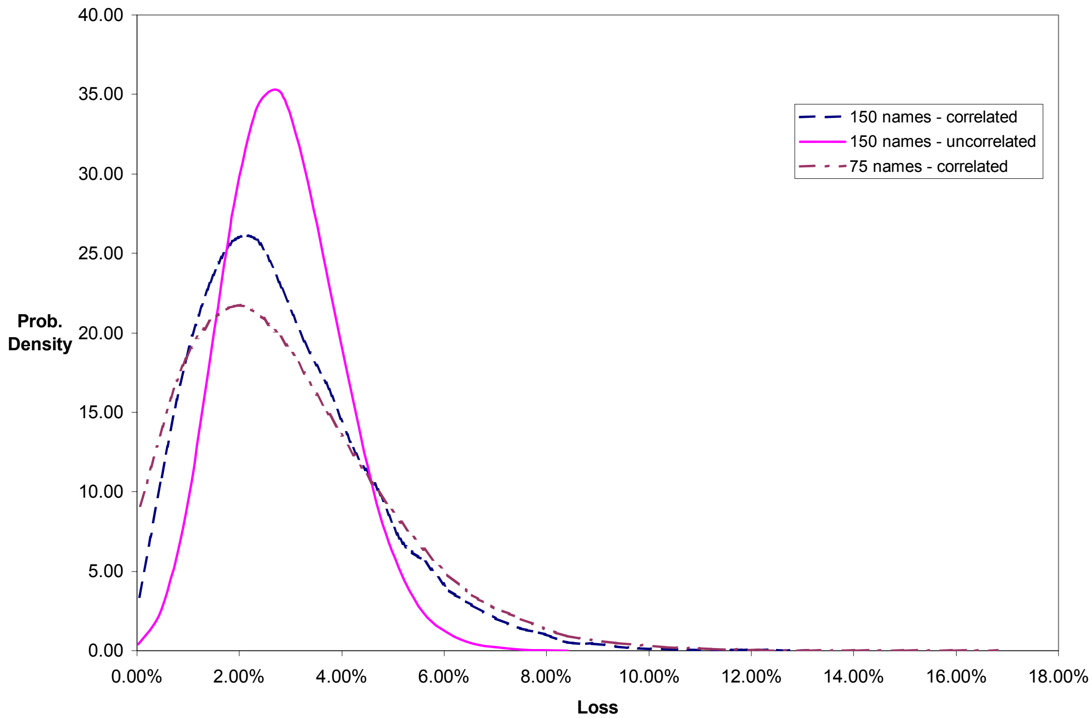
Correlation Assumptions

Whenever a portfolio of entities is assembled, one essential consideration is how closely their behaviour is associated with one another. In the analysis of credit portfolios, this is captured in the correlation analysis. In considering correlation, a distinction should be made between implied correlation, i.e. correlation that is priced within the marketplace for a particular pool, and the correlation assumptions that are assigned for the purposes of credit-risk modelling. In the pricing of a credit portfolio, there are implicit correlations assumed in terms of defaulting entities and how they affect the outcome of such pricing. In effect, implicit in the pricing of the tranche is a level of correlation within the pool, much like how in the option world, implied volatility is also reflected in the price of the option.

Compared to the pricing of credit derivatives, credit risk modelling takes a different approach to the issue of correlation. In the modelling of credit portfolios, correlation assumptions are made with respect to assigning correlations between individual entities. The assigned correlations impact the probability of default for these individual entities. To the degree various entities are correlated in their probabilities of default, the resultant aggregate loss profile on the pool may look drastically different from those of a non-correlated portfolio (see Chart 1). The primary effect of correlation of default between names is that the more correlated the entities, the more the tail of the loss distribution widens out and as a result, the higher the required credit enhancement to cover off a given percentile of loss outcomes.

If correlation is important in describing and understanding the loss distribution, the issue then becomes how to establish correlation assumptions. One way to organize correlation is around the concept of industry classification. If industry classification is used, correlation can appear in two potential forms: (1) between Reference Entities within an industry class; and (2) between Reference Entities in different industry classifications. In the assignment of correlation, DBRS looks mainly at the assignment of correlation to entities within the same industry. Typically, standard industry classifications are used to categorize entities within industries. However, notwithstanding the industry categorizations, there are some relationships between Reference Entities that may not be captured by industry classifications. For example, a portfolio with a large number of travel-related names may seem quite diversified given that various industry categorizations include airlines, hotels, amusement parks, etc. However, it is obvious that these industries are highly exposed to travel-related concerns (terrorism, high energy process, currency movements, etc.) and hence such risk would not necessarily be properly reflected in industry categorization alone. To the degree DBRS observes such relationships, adjustments are made accordingly.

Chart 1: Illustrative Loss Distributions



Concentration Issues

Concentration issues for portfolios can appear in several forms. However, for discussion purposes, the focus will be on Reference Entity concentration, industry concentration, and geographic concentration.

Name Concentration – Diversity

As a basic characteristic of any portfolio, the more names included, the lower the exposure to any one name, given equal weighting. The opposite is true in that the fewer the names included, the greater the concentration of exposure to any one name. Unlike equity portfolios where diversification can be achieved quite easily, it is far more difficult to achieve diversity in credit portfolios. The effects of name diversity are directly observable in the Monte Carlo modelling process. Due to the fact that increased concentrations result in higher percentage losses to the pool per defaulted entity, the loss distribution in a more concentrated pool warrants a much wider distribution and effectively a longer "tail". As a result, higher enhancement levels are required to cover off a given percentile of loss outcomes (see Chart 1). It is only after a considerable number of names are added that this effect begins to dissipate.

In the case where the number of obligors is quite low and much of the diversification effects of the pool are no longer available, simulation modelling becomes much more difficult since the results of simulation modelling become far less granular and far more step-like in appearance. Setting enhancement through the use of percentiles becomes much more difficult and subjective. Additionally, the simulation results also become progressively more sensitive if the size of the different Reference Obligations can vary.

In situations where the number of Reference Obligations are very small, it is likely to be in a credit default swap structure where it may be based on a first to default concept. In these situations, DBRS would generally look at the probability of default for the lowest rated entity and then closely examine the recovery prospects for that particular entity. This can be a difficult exercise, keeping in mind the variation of recovery levels. In other situations, and depending on the Reference Entities, DBRS may apply this type of approach to more than the ostensibly lowest rated Reference Obligation and again look at the recovery analysis. In these situations, the enhancement is likely to be set on the basis of the largest loss. From a modelling perspective, the difficulty with this type of structure is that it is heavily dependent on the recovery analysis. The recovery analysis is a function of the assets and liabilities of the entity and is also subject to the dynamics of any liquidation or reorganization of the entity. DBRS accounts for the uncertainties involved in the recovery process by using assumptions that are commensurate with the desired rating.

Industry Diversity

Experience suggests that companies within an industry tend to perform with a higher level of correlation than with the economy in general, particularly during an economic downturn. DBRS has industry diversification requirements that limit the exposure to a particular cyclical downturn affecting one industry. Given that each industry reacts differently to the economic environment, and as such, may lead or lag the start and conclusion of the downturn, or may actually be countercyclical, a diversified portfolio is less likely to experience higher default levels than average and is less likely to experience catastrophic spikes in defaults. For cash flow CDOs, spreading out defaults is an important part of maintaining appropriate cash flows to investors. Industry concentration effects are essentially captured in the correlation assignments as described above and are ultimately reflected in the overall enhancement requirements on the pool.

Geographic Diversity

Geographic concentration is a far smaller concern than the previous two, but may have some impact for particular loan portfolios. Geographic concentration tends not to be a concern because obligors are often dependent upon a wide variety of customers that extend nationwide if not internationally. As such, notwithstanding notional geographic concentration, default correlation of individual loans of geographically concentrated obligors is likely to be quite low (after excluding industry and general economic factors). Only where the industry is dependent upon a localized customer base or for small businesses, will geographic concentration become a more significant concern. Unless these specific concerns are present, no specific geographic concentration limits will generally be implemented. As an exception to the above, geographic concentrations are a critical factor in evaluating real estate-related obligations or potentially a portfolio of small business loans.

On the issue of Industry and Geographic diversification, it is important to keep in mind that although having limits is in principle a positive construct, it may sometimes cause situations where a manager, for the sake of managing a pool within certain limits, ends up having to select obscure and possibly lower quality Reference Entities just to meet certain criteria and pass up on other potentially positive names notwithstanding the limits. As a result, DBRS's view is that such limits should be set with some flexibility and reasonableness while taking into consideration the particular objectives of the manager and the transaction at hand.

APPLICATION OF APPROACH TO SINGLE-LEVEL CDOS

General Structure

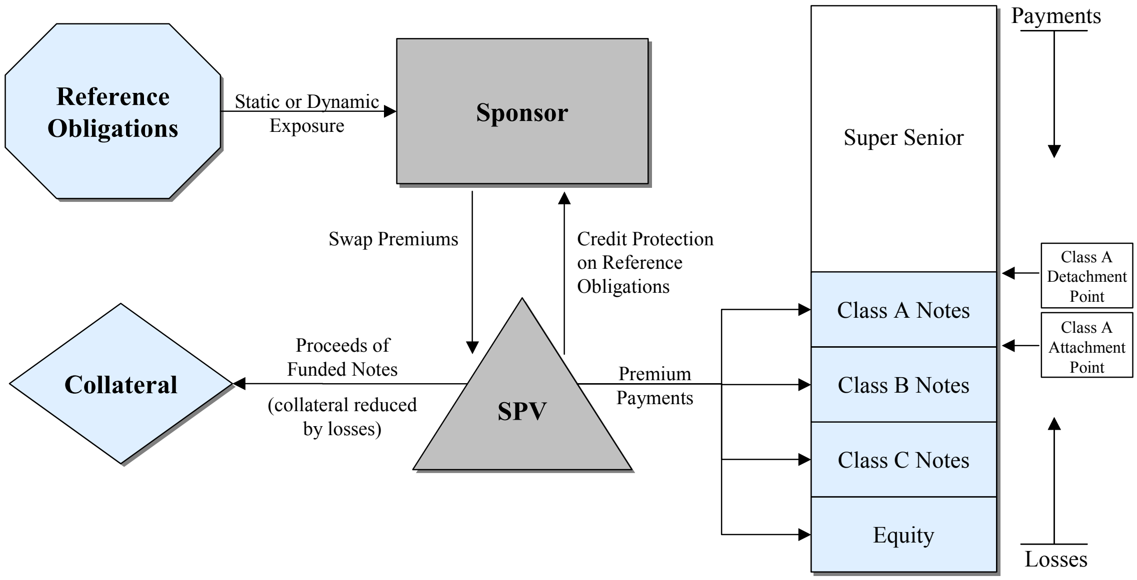
In its simplest form, a single-level CDO basically serves the purpose of carving up the aggregate portfolio credit risk of a single portfolio into various tranches, each with their own risk/return characteristics. This tranching creates unique opportunities for investors interested in engaging CDO transactions at risk/return levels in line with their particular appetites and preferences.

The single-level structure is commonly used in both synthetic and cash transactions. Reference Obligations can potentially span a wide range of asset classes from bank loans to bonds, corporate names, tranches of other ABS transactions, mortgage-backed assets, and more recently insurance and bank trust preferred instruments. In addition, transactions can be either static or managed, in which case the rating approach is slightly adjusted to reflect minimum criteria. Investors have generally understood that different types of Reference Obligations may have different default and migration characteristics. In the past, this has prompted the widespread application of ABS and CMBS instruments in CDO applications.

In a typical transaction, losses are allocated to tranches in a sequential manner, starting with the most junior tranche. Each tranche will have its own attachment point and detachment point. The attachment point can be thought of as the point at which losses (net of recoveries) in the Reference Portfolio directly begin to impact the tranche in terms of first dollar loss. The detachment point can be thought of as the point at which the particular tranche has been eliminated through the allocation of losses (net of recoveries) from the Reference Portfolio. At this point, losses are then allocated to the next more senior tranche in the capital structure. This process is repeated if and when losses occur until the termination of the transaction. In this type of structure, junior tranches act as credit enhancement to more senior tranches.

Not all structures, however, consist of multiple tranches. Transactions can be designed with a single tranche. In this type of design, an investor can select the attachment and detachment point of their tranche. The investor benefits from synthetic enhancement to the degree that the attachment point is set above a certain first dollar loss level on the Reference Portfolio. From the investor's perspective, the investor can select a particular risk/return profile by selecting an attachment point that applies after a certain dollar loss on the Reference Portfolio. This type of structure leads to an alternate view of tranches, detachment points and attachment points. Specifically, one can think of the attachment and detachment points of each tranche as corresponding to covering off specific percentiles of the loss distribution for the Reference Portfolio.

Diagram 1: Typical Single-Level CDO Structure



To describe the loss behaviour mathematically: if credit enhancement (attachment point) on the particular tranche is represented by A_t, the detachment point represented by D_t and actual losses on the aggregate portfolio represented by L.

Then, losses on the tranche L_t can be characterized as follows:

$$L_t = MIN\{MAX[(L - A_t), 0], (D_t - A_t)\}$$

Where the MIN and MAX functions return the lowest and highest value arguments respectively.

As described by the above equation, in the case that $L \leq A_t$, no losses are realized for the tranche ($L_t = 0$). In the case where $A_t < L \leq D_t$, losses to the tranche would equal the difference between the aggregate pool loss and the attachment point for the tranche ($L_t = L - A_t$). In the final case where aggregate pool losses exceed the detachment point of the tranche, losses to the tranche are simply capped by the size or thickness of the tranche ($L_t = D_t - A_t$), essentially a 100% loss scenario for the tranche.

Modelling Process

The modelling process has generally been described in an earlier section of this methodology. In this particular subsection, DBRS applies the general modelling process to a hypothetical portfolio. The intent in this exercise is to establish attachment points for the tranches such that the level of risk for each tranche is commensurate with the desired rating of the tranche. For further details on the modelling process, see the Appendices to this Methodology.

Following the analysis set out above for modelling, and after assigning the pertinent parameters to the model reflecting the portfolio at hand, the Monte Carlo simulation process is carried out. Defaults, recoveries, and other parameters are simulated for each underlying Reference Obligation, on an individual basis, and aggregated to generate loss distributions on the overall Reference Portfolio. As noted, with the analysis complete, it is possible to align or create tranches based on specific percentile ranges for the loss distribution from the pool.

This does not answer the question, however, of how particular tranches, and particular parts of a loss distribution, actually correspond with a rating. DBRS's approach on this point is to look at the probability of loss as exemplified by a particular percentile of the loss distribution, and how it corresponds to the actuarial probability of loss as derived from actuarial default studies. DBRS determines these levels such that loss expectation on each tranche, net of enhancement effects, closely mimic those of similarly rated debt obligations. For example, if AAA debt obligations have a cumulative default probability of Δ over a five-year term, then for a CDO tranche to achieve the same rating over the same term of five years, the offered attachment point for that tranche needs to cover off at least (1 - Δ) of possible loss outcomes as shown in the loss distribution. Mathematically, this can be shown as:

$$\Delta = \lambda / \Phi$$

where,

$$\Phi = \int N(L)dL \Big|_{MINL}^{MAXL}$$

N(L) is the loss distribution function as determined via the Monte Carlo simulation output, while:

$$\lambda = \int N(L)dL \Big|_{L^*}^{MAXL}$$

By solving for L*, the required level of enhancement in the transaction is obtained. Therefore, L* is the point at which the risk is commensurate to the desired rating level and represents the minimum acceptable credit enhancement. From this approach it would follow that for tranches where offered attachment points are above and beyond the minimum threshold required for a particular rating, that tranche would also achieve at least such rating (and perhaps an even higher rating if the level of enhancement warrants).

Sensitivity Analysis

So far in the discussion, the focus has been on the ultimate determination of appropriate tranche credit enhancement or attachment points. The importance of conducting sensitivity analysis methodology will now be highlighted. The purpose of conducting sensitivity analysis is to ensure that the level of credit enhancement is not only sufficient to cover off tranche losses at a particular rating level, but also to ensure that the rating of the tranche will not be adversely affected should a reasonable level of ratings migration or defaults occur in the underlying portfolio entities within certain time horizons. In other words, the objective is to guard against a situation where the provided credit enhancement is only minimally sufficient to achieve a rating, from the loss outcome perspective, but insufficient to withstand any credit deterioration in the underlying portfolio that may occur in short order. The exercise is particularly useful when the distribution of credits in the portfolio have a wide dispersion from the portfolio WARF. The concern in this situation is that the overall performance of the transaction may be particularly dependent on the credit performance of lower rated Reference Entities in the pool. While not a part of the ratings process per se, DBRS will provide sensitivity analysis as required by the investor.

Migration Sensitivity

One way to understand sensitivity is to review migration risk. Based on migration studies, for a given rating, there is a probability of a particular rating staying the same, improving, or deteriorating over a one-year time period. Generally, the higher probabilities are associated with either the rating staying the same or moving downward. These general probabilities are incorporated into the credit risk modelling. While useful, these rating migration probabilities may not specifically incorporate more stressful economic environments. The concern with a CDO pool is what happens to migration probabilities in a more stressful environment. To approach this issue, DBRS will apply stressed rating migration scenarios to the portfolio and review their impact over various timeframes over the tenure of the transaction. Typically for a transaction tenure of five years, a one-year and two-year time horizon will be evaluated. The focus is on the first two years since this is the time period when the transaction is most sensitive to downward migration. The migrations analysis consists of simulating rating transitions for each of the individual portfolio entities and reviewing loss expectation at those time horizons and comparing them with remaining credit enhancement. The simulation of migration and recalibration of enhancement gives a good sense of how resilient the ratings will be if credit deterioration occurred or if the portfolio was exposed to a more pressured credit cycle.

Default Sensitivity

The approach taken to migration sensitivity is also applied from a default perspective. In this situation, however, the analysis consists of simulating default occurrences for the portfolio at various time horizons and considering their impact on remaining credit enhancement. In selecting particular Reference Obligations to stress, DBRS particularly concentrates on the lower rated credits. As noted, this helps capture the vulnerability of the transaction to lower rated credits. In this analysis, the loss outcomes are compared to the remaining capital structure to ensure that it is sufficient for the remaining life of the transaction, notwithstanding the default occurrences.

APPLICATION OF APPROACH TO MULTI-LEVEL CDOS

General Structure

Evolution in the structured finance market, in conjunction with changing spread levels, has seen the introduction of a variety of new products over the past couple of years. Of these financial innovations, perhaps the most significant is the multi-level CDO structure. Fuelled by the efforts of investment banks to restore profitability as corporate spreads have declined, and by investors looking for yield in a low interest rate environment, multi-level CDOs have experienced significant growth. Although structures can differ, the typical multi-level CDOs consist of a large segment of ABS product and a smaller segment of other corporate CDOs as Reference Obligations. DBRS has seen the underlying CDOs comprise between 5% and 100% of the Reference Portfolio for these transactions. The interesting point about the multi-level structure is that an underlying CDO tranche can translate to any percentage of the capital structure in the overlying CDO. As this percentage is increased, the leverage of the individual CDO tranche is also increased. As will be seen, this ability to adjust leverage is an extremely important point. The other interesting point is that the underlying CDOs may feature name repetition with respect to Reference Obligations. This may accentuate concentration and leverage effects at the level of the overall structure.

Diagram 2: Illustrative Composition of a Multi-Level CDO

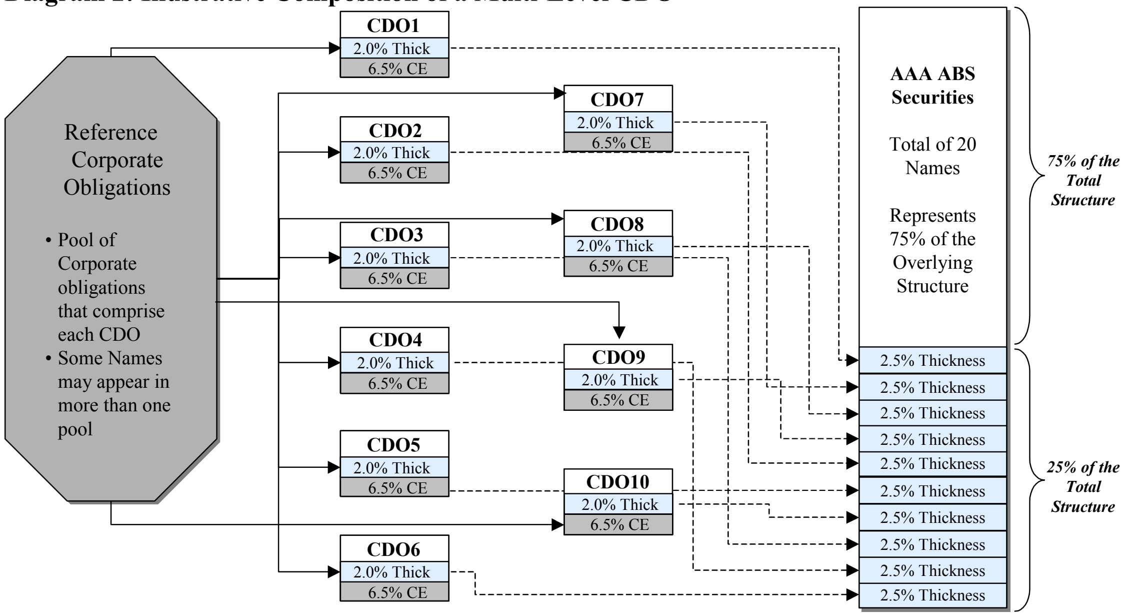


Diagram 2 above depicts a simplified structure of a multi-level CDO. For simplicity, illustrated above is what is commonly referred to as a CDO squared (i.e. CDO of a CDO), where there are two levels of CDOs. Although there are structures that have more layers – for instance a CDO cubed, which is comprised of three layers of CDOs – the remainder of this discussion will be limited to CDO Squareds, as the concepts and approaches are fundamentally similar.

Each underlying CDO Reference Obligation generally represents a single-level CDO, which is comprised of corporate obligations and is structured with subordination levels depending on the rating of the tranche. For purposes of analysis, what is critical is the particular tranche within the underlying CDO that is selected to be the Reference Obligation for the overlying Reference Portfolio. As such, any losses associated with the underlying CDOs will only impact the overall structure when they exceed the underlying subordination of the particular tranche for each underlying CDO. Mathematically, if credit enhancement on the underlying CDO_i is A_i, actual losses on the underlying CDO_i are L_i, and the sum of all i is equal to the total number of underlying CDOs.

Then losses on the overlying structure are realized when:

$$L_i > A_i$$

If $L_i \leq A_i$, then no losses are realized. In other words, they are equal to zero as there are no losses that flow to the overlying structure.

Hence the simplified aggregate impact on the overlying structure, can be described as the sum of all realized losses on each of the underlying structures.

$$L_o = \sum_{i=1}^{n} MAX\left[(L_i - A_i),0\right] \qquad \text{Equation 1}$$

Recoveries on the intermediary CDO tranches are not specifically addressed since, in the evaluation of losses at the intermediary level, losses attributed to those tranches are net of recoveries available on the defaulting underlying Reference Obligations at the first level.

As noted above, the CDO portion of the overall transaction is generally only part of the concern. Generally, the overlying structure may also be comprised of other securities in addition to the CDO tranches. Typically, this tends to be traditional ABS securities, but in reality the structuring institution could use any type of obligation. As such, the losses on the overlying structure will be a function of the losses on the CDO tranches (as described in Equation 1) plus any losses on the additional securities. This can be described mathematically as:

$$L_o + \sum_{j=1}^{n} L_{sj} \qquad \textit{Equation 2}$$

where L_{sj} is the loss realized or expected on each additional security j; the sum of all j is equal to the total number of additional securities.

Losses that are realized on L_{sj} will be dependent on the nature of the security represented by L_{sj}. For instance, if L_{sj} was a rated corporate entity, then DBRS would apply simulated defaults based on the rating of the entity. Likewise, if the L_{sj} was an ABS security, DBRS would apply the applicable default rate associated with the rating of the ABS security. It is important to note that DBRS does not differentiate default rates between corporate and ABS obligations. Although this is a conservative approach, it guards against the possible risk that ABS default rates will converge with corporate default rates over time. This is a possibility as decreasing enhancement levels for a variety of ABS asset classes have been observed. Hence, the same default curve is used for all rated securities despite the nature of the instrument. Having said that, recovery assumptions are not as severe since DBRS does give credence to the higher levels of recovery expected of ABS instruments. Distinctions are made, however, between types of ABS asset classes and the seniority of the Reference Obligation instrument.

Evolution in Approach and Modelling

For the most part, the modelling and quantitative approach to multi-level CDOs is similar to those used in single-level CDO transactions – defaults are simulated on the underlying corporate obligations using a ratings-based default curve, and the overlying attachment point is determined based on the acceptable risk associated with the desired rating. Although the fundamental approach used on single-level transactions is applicable to multi-level CDOs, several important, yet subtle, distinctions and modelling adjustments must be made to accommodate the complexity of these transactions in order to better capture the actual workings of the transactions.

<u>Default Engine</u>

In single-level transactions, default simulations are run on a portfolio of corporate names in order to generate default and loss distributions. For multi-level CDOs, the underlying CDO tranche has an associated portfolio of corporate names that will require simulations to be used. However, Referenced Obligations that appear in one underlying CDO may also appear in another underlying CDO as well. As such, if a default were to occur on this particular overlapping Reference Obligation, it would impact each and every CDO tranche in which it was referenced. Therefore each underlying CDO portfolio cannot be viewed as independent from the others, as overlapping names will have a multiplicative impact on the transaction. In order to deal with this overlap, and to correctly model the transaction, DBRS uses a default engine that houses all Reference Obligations used in the transaction. Names are then referenced from the default engine to each of the CDOs, such that any name overlap is correctly captured. Simulations are then run on the names that appear in the default engine, using the same assumptions as in the single-level CDO case.

<u>Credit Enhancement of the Underlying CDO ("Attachment Point")</u>

As mentioned earlier, each underlying CDO is essentially a single-level CDO. Accordingly, the subordination level for each of the underlying CDOs will be dependent on the desired rating of the tranche to be referenced. In essence, this attachment point represents the point at which losses begin to occur for the rated tranche. Typically the attachment point is given to DBRS by the structuring institution and this level is fed into the model. This attachment point is what is referred to as A_i in the earlier discussion. From time to time, DBRS is asked to establish the attachment point for the underlying CDOs for a desired rating by the structuring institution. If this is the case, then DBRS would establish such a point by using the standard methodology, as discussed earlier.

Fundamentally, the actual rating assigned to an underlying CDO tranche is not of primary concern to DBRS. It is more important to consider the strength of the attachment points, and the level of losses that they are able to absorb, before such losses begin to flow up to the overlying structure. From DBRS's perspective, the issue is then the particular percentile of the loss distribution to which the attachment point applies. Stated differently, a structuring institution could deem the attachment point of the underlying CDO AAA (based on their own view or on the view of another rating agency), but what is more important is the level of losses that flow through (i.e. the loss outcomes that may occur above this threshold). Hence, the model is not run off the implied rating of the tranche, but off of the actual attachment point. This compensates for differences in attachment points for a given rating assigned by different rating agencies. In avoiding differences between rating agencies on underlying CDOs that have previously been rated, the modelling is designed to replicate the loss characteristics of the actual transaction (incorporating the transaction design and structuring features). As described in Equation 1 earlier, simulated losses flow from the affected Reference Obligations to each applicable underlying CDO where the affected Reference Obligations appear and where losses exceed the attachment point for the underlying CDOs and then up to the overall structure. The aggregate of such losses will determine the loss distribution of the overall Reference Portfolio (also taking into account any additional securities), and not the actual rating of the underlying CDO tranches.

<u>Detachment Point and Thickness</u>

While the attachment point indicates the point at which losses begin for the underlying CDO tranche, the detachment point indicates the point at which losses stop. In other words, the detachment point is the level at which losses, represented in percentage terms, equals 100% of the particular CDO tranche. To illustrate the point, consider the following simplified capital structure: credit enhancement for the AA tranche of an underlying CDO is 5%, while the credit enhancement for the AAA tranche of the underlying CDO is 7%. If the AA tranche was used in a multi-level CDO transaction, then any losses generated via the corporate default simulation would not impact the overall Reference Portfolio until losses were greater than 5% in the underlying CDO structure. If losses exceed 5% in the underlying CDO, these losses would translate into losses at the overall Reference Portfolio level. However, losses would cease flowing up to the overlying structure once they exceed 7%. Any losses above the 7% level would be impacting the AAA tranche, while the AA tranche will have already lost its entire principal amount. The difference between the attachment and detachment points for the underlying CDO can be referred to as the "thickness" of the

CDO tranche. While in this case the "thickness" of the AA tranche has been set at 2%, it could be set at any level of thickness desired. The critical point to understand here is that the "thickness" of the underlying CDO tranche translates to a decision about leverage.

With this in mind, the modelling must take the detachment point into account, and mathematically, Equation 1 can now be more accurately represented as:

$$L_o = \sum_{i=1}^{n} MIN\{MAX[(L_i - A_i),0], W_i\}$$

Equation 3

where W_i, is the thickness of the tranche, with thickness equal to:

$W_i = D_i - A_i$, where D_i is the detachment point of the tranche.

Hence, losses cannot exceed the maximum, which is defined as the size of the CDO tranche being offered for the transaction.

<u>Leverage</u>

The relationship between losses on the underlying CDO and the overall Reference Portfolio may not be one-to-one, but may ultimately depend on the leverage in the structure. Moreover, the tranche thickness does not necessarily correspond to an equal potential loss in the overlying structure. For instance, using the above example, the thickness of the AA CDO tranche was 2%. However, in the overlying structure, this CDO security could represent 5%. The relative sizing of the AA tranche of the underlying CDO compared to the sizing of the tranche in the overall Reference Portfolio is a critical point. The difference in sizing between these variables will effectively leverage any losses into the overlying structure. In the given example, a 1% loss in the AA tranche translates into a 2.5% loss in the overall Reference Portfolio, equating to a leverage of 2.5x. In the synthetic case, the interesting point about this leverage factor is that it can be increased or decreased for any given transaction. Moreover, leverage can be adjusted by changing the thickness of the underlying CDO tranche or by making the underlying CDO a larger part of the overall capital structure. Instead of the overlying CDO tranche representing 5% of the Reference Portfolio, it could represent 10% (such that the leverage is now 5x given a 2% thickness on the underlying CDO tranche). By changing the percentage of the overall capital structure represented by one underlying CDO, different leverage levels can be realized for each underlying CDO (i.e. the leverage could be the same or different for each underlying CDO). For obvious reasons, it is critical that the modelling in multi-level CDOs accurately reflects the transmission of leverage between the different levels.

To more accurately reflect this in mathematical terms, Equation 3 can now be defined as follows:

$$L_o = \sum_{i=1}^{n} \alpha_i MIN\{MAX[(L_i - A_i),0], W_i\}$$

Equation 4

where α_i is the implied leverage between the underlying CDO tranche to the overlying structure.

In the example, the implied leverage (i.e. α_i) between the tranches is 2.5x where the tranche represents 5% of the overall Reference Portfolio.

Following on what was discussed regarding the ability to change the leverage for an individual underlying CDO, the total exposure, as a percentage of the overlying structure, can be represented as:

$$\sum_{i=1}^{n} \alpha_i W_i$$

Equation 5

Equation 5 represents, in percentage terms, the total size of the CDO portion of the deal. Theoretically, the CDO portion could represent up to 100% of the overlying structure. However, as the CDO portion increases, the transaction becomes increasingly sensitive to the CDO effects, and ultimately the underlying Reference Obligations. For example, consider two different structures: (1) the CDO portion is 10%; or (2) the CDO portion is 100%. In the latter example, overlying transaction is completely sensitive to the underlying CDO tranches, and hence the variables that drive the credit risk (i.e. leverage, name overlap, default assumptions etc.). On the other hand, in the first example, the CDO portion represents a very small portion of deal. Nonetheless, and depending on the overall enhancement at a given rating level, the ratings volatility of the CDO tranches in the overlying structure can be quite sensitive to the credit behaviour of the respective underlying CDOs. Moreover, it is also critical to understand that small changes in these leverage factors can have a material impact on the loss distribution of the transaction, notwithstanding such changes may otherwise appear benign on the surface.

<u>Name Overlap</u>

In a multi-level CDO, and apart from the leverage between levels of the structure discussed, there is a further form of leverage compared to single-level CDO structures. This additional form of leverage appears through the use of name overlap. As an example, and if it's assumed there are between 300 to 500 liquid names in the corporate credit default swap market, but there are ten underlying CDOs, each with 100 names (for a possible 1,000 name total) in a multi-level structure, there will inevitably be some degree of name overlap among the underlying CDO. Hence, the overall exposure to such a name is a direct function of the number of times it appears in the underlying CDOs. As discussed earlier, to deal with the impact of name overlap, DBRS uses a single default engine that houses all corporate obligations. From this default engine, names are then referenced into the applicable intermediary securities, such that a default or credit migration will be captured properly across all affected securities. This treatment more closely replicates the real nature of such credit events and their impact to the overall structure.

The issue with name overlap is that it exacerbates any negative events, namely defaults and credit migration. The extent of this effect is directly related to the number of times the name appears in the overall structure. In other words, if a name appears in all ten CDO pools, then any defaults in that one name will impact all ten CDO pools. Obviously a name only appearing once will have no repeating impact on the overall structure. Hence if all names only appear once, then each underlying CDO would be entirely independent. Following from this, as the name overlap between names increases, the independence of each of the underlying CDO securities becomes lessened (i.e. they become more and more correlated). An extreme case is where all underlying CDO securities are exactly identical, in which case they have 100% correlation. In general, the lower the overlap, the less correlated the pool, resulting in a structure with lower potential volatility.

To complete the analysis, the ratings of overlapped names must also be evaluated. The overlap of high quality names rather than low quality names is a much better scenario from a risk perspective. To have an AAA-rated security appear in more than one CDO security is less risky than having a B-rated security appear in multiple securities. To help understand the overlap dynamics of a given multi-level CDO transaction, an overlap chart that is based on rating and the number of times such a name occurs is used to evaluate the pool. To see this in use, refer to the Case Study in the Appendix B for greater detail. The point of assessing this overlap chart, and then carrying out migration and default sensitivities with respect to these names, is to understand how much of the actual risk of the overall transaction is concentrated on what would otherwise appear to be a very small portion of the transaction (i.e. a small group of corporate names in a small group of CDOs that make up a small amount of the Reference Obligations in the overall Reference Portfolio). This is another important example of where the modelling should capture how actual losses flow through the overall transaction structure and where it can be extremely deceiving to look at a broader actuarial approach to these transactions.

Setting Credit Enhancement in Multi-Level CDOs

With the above variables established and defined, simulations can be run on the overall portfolio. Such simulations are essentially the same as in the case for single-level transactions, where defaults are simulated via a Monte Carlo process. In DBRS's original methodology, these defaults are driven via the implied, term-dependent, default rate based on rating. In addition, intra and inter-industry correlations are used to drive such simulations.

The loss on the overlying structure is aggregated as per Equation 2, where Equation 4 now defines the loss profile generated via the intermediary securities. The resulting loss distribution from such simulations is now the loss distribution for the overlying Reference Portfolio and its respective tranche(s).

Credit enhancement on this structure is based on the desired rating level to be achieved. In other words, if a AAA rating is requested, with an associated default rate of Δ (represented as a percentage), then the tranche must be enhanced to absorb at least 1- Δ of all losses. By doing so, the investor is left holding only the risk associated with other instruments that are also rated at the same level. The same is true for all other rating categories.

It is important to note that the loss distribution on the overlying instrument can be very different from the loss profiles of the underlying CDOs. There are various reasons for this difference. In particular, the tranche of the underlying CDO is enhanced to cover off a certain percentile of losses. If, for example, the attachment point for a given tranche is set to achieve a lower rating, there is a greater likelihood that simulations will result in a complete loss in the underlying CDO tranche. If this happens to an increasing number of underlying CDO tranches, it can result in a relatively flat loss distribution on the overlying CDO portion (which implicitly suggests that overall losses can be small or large, with equal probabilities). On the other hand, if the enhancement on the underlying tranches is set at the tail of the loss distribution for each underlying CDO (such that each tranche would be highly rated if rated in isolation), the overall loss distribution, as it relates to the CDO portion, will often exhibit minimal losses. Another factor that affects the loss distribution on the overlying structure is the explicit leverage between the underlying and overlying CDO tranches. This leverage factor changes the shape of the overall loss distribution and pushes out the tail. Moreover, name repetition can also have an impact on the overall loss distribution since in many ways, it is equivalent to a high degree of correlation. The last factor is that the overall loss distribution will also include whatever contribution is made by the non-CDO Reference Obligations. This contribution, although modest in terms of absolute loss, can play a significant role in determining the overall credit enhancement depending on the resultant sizing of the CDO portion, in relation to the non-CDO portion.

As is the case for single-level CDOs (see relevant section), a sensitivity analysis is run on the transaction to determine the resilience of the chosen attachment point to negative migrations and defaults. With this information, an investor is better positioned to compare the risk/return profiles of various CDO transactions. In addition to looking at the rating and premium paid, an investor should also be considering credit migration risk to determine whether a particular CDO is suitable.

Caveats and Considerations

Multi-level CDOs create additional challenges since determining the credit enhancement for these transactions introduces additional complexities and subtleties. As a general theme, while an actuarial approach can give a relatively accurate picture in single-level transactions, this can be dangerously misleading in multi-level CDO transactions. Risk can only be understood in multi-level transactions through simulation structures that mimic the flow of losses through the overall structure. In this respect, when looking at the underlying CDOs, one must simulate potential defaults on each and every CDO tranche. In addition, this analysis must also take into account the name repetition among the underlying CDOs as well as the leverage factor between the underlying and overlying structures. Failure to accurately account for these variables will produce misleading modelling results.

There are a number of implications that follow from an examination of multi-level CDOs. Firstly, small changes in key variables can produce large differences in the loss distribution. Secondly, it is more difficult and complex to compare multi-level CDO transactions with one another. Thirdly, multi-level CDOs may have different migration and risk characteristics. In particular, some structures may be vulnerable to a smaller number of riskier elements in the underlying structure that can have a large impact on the overall credit quality of the transaction if these individual Reference Obligations deteriorate. Fourthly, and due to some of the above points, investors should not necessarily look only at CDO pricing versus rating to make their investment decision.

The following discussion will address the above points in greater detail:

<u>High Level of Sensitivity</u>

A single-level CDO usually has some degree of leverage. Leverage, however, can be exacerbated or magnified in a multi-level CDO by: (1) setting enhancement on the tranches of the underlying CDOs at low levels; (2) keeping tranche thickness of underlying CDOs relatively thin; (3) introducing explicit leverage between the different levels of the CDO structure; and (4) increasing name repetition. Each of these variables can have a material impact on the credit risk and volatility of the overlying structure. The impact of these factors, whether in isolation or combination, is often non-linear. Unlike a single-level CDO, it is difficult to understand the risk of a multi-level CDO without sophisticated modelling. Moreover, the relative level of risk in small transactional changes can only be understood through the re-modelling of the transaction to determine the impact of the change. In general, the greater the sensitivity of the structure, the greater the credit enhancement required to mitigate sensitivity. This will not only be reflected in the initial modelling of the credit enhancement, but will be captured via the sensitivity analysis used to test the resilience of the chosen attachment point.

With these leverage factors in mind, investors should be aware that there is a greater chance of encountering an extreme loss scenario in a multi-level CDO. Outcomes will likely be clustered close to the 0% loss level for the CDO portion, if the transaction is structured relatively conservatively. However, there are combinations of defaults and credit migrations that could cause the tail of the loss distribution curve to be quite wide. Hence, the maximum potential loss could actually be quite large in relation to the expected loss. For example, the expected loss for a multi-level CDO could be 50 basis points, however the maximum loss outcome could be 30% or greater. It is important to note that the 30% loss outcome could represent only one instance out of a total of 500,000 trials, and is therefore quite rare. However, this loss is quite material, and should not be discounted without further analysis. Different CDOs can have different probabilities with respect to these extreme loss events.

In some cases, the analysis of the loss distribution could have a tail that does not lend itself to meaningful statistical analysis. Hence establishing credit enhancement to cover off a certain percentile of loss outcomes may not be the most meaningful measure of the true credit enhancement required in the transaction. In such circumstances where the tail is significantly wide and the maximum potential loss generated via the Monte Carlo simulations is drastically greater than the mean outcome, DBRS regresses a function in an attempt to describe the loss curve. In doing so, the function conservatively describes the potential frequency for a given level of loss. Having determined the function that “best fits” the simulated loss distribution, the area under the curve can be calculated to determine the appropriate level of credit enhancement depending on the desired rating. The area under the curve is simply:

$$\int f(L)dL$$

where f(L) is the regressed function for the loss distribution curve and L is the specific loss in %.

Hence, the total area under the curve can be described as the integral between the minimum (in most instances zero) and maximum simulated loss amounts:

$$\Phi = \int f(L)dL \Big|_{MINL}^{MAXL}$$

To determine the appropriate attachment point, the area under the curve, in percentage terms, must be equal to the level of risk commensurate to the desired rating level. If the desired rating level has a loss expectation of Δ (defined as a percentage), then the resulting credit enhancement is the point at which the area under the curve is equal to Δ of the total area.

$$\Delta = \lambda / \Phi$$

where,

$$\lambda = \int f(L)dL \Big|_{L^*}^{MAXL}$$

By solving for L*, the required level of enhancement in the transaction is obtained. Therefore, L* is the point at which the risk is commensurate to the desired rating level and represents the minimum acceptable credit enhancement.

The regression of the loss distribution creates an additional layer of conservatism by implicitly placing additional weight on the rare, but material loss outcomes in the tail. However, it is important to highlight that the attachment point does not eliminate the potential risk of these outcomes. Hence, the investor is still potentially susceptible to these extreme loss scenarios. Such considerations should not be ignored when evaluating multi-level CDO portfolios, especially within the context of investor suitability.

Evaluating Different CDOs

Investors are often faced with choices from various investment banks to purchase different CDOs. Often, investors seem to choose CDO tranches on the basis of which CDO tranches pay higher premiums, given a particular rating category. DBRS believes this is not necessarily the best way to approach the investment decision, as the investor must first understand how a particular rating agency arrived at the rating. Specifically, the investor should understand a number of key issues:

(1) Whether or not the rating is reflective of the minimum amount of enhancement necessary to achieve a particular rating category;
(2) To what degree the modelling assumptions are conservative or aggressive;
(3) The extent of cushion, if any, that exists between actual and required minimum credit enhancement; and
(4) To what extent the transaction is capable of dealing with rating migration risk.

Without understanding and evaluating these issues, DBRS does not believe that merely considering the rating is sufficient for an investor to gain comfort. It can often be the case that, for the same rating, one transaction, while offering a lower premium, may be far more resilient when it comes to rating migration risk than another transaction offering a slightly higher premium. DBRS has found that the risk/return relationship for multi-level CDOs is highly non-linear and that relatively small reductions in premiums can lead to transactions that are far stronger from a risk migration perspective.

Migration and Risk Characteristics

As noted, different CDOs may have very different migration and credit risk characteristics. To the degree that modelling is solely performed to achieve a minimum acceptable enhancement level for a particular rating, the concern can become that, through a variety of structuring techniques (such as overlapping lower quality Reference Entities, using lower attachment points, using thin underlying CDO tranches, etc.), time-based migration, and credit risk characteristics may not be appropriately captured. As a result the overall quality of the portfolio may deteriorate at varying speeds. Due to the number of variables that can impact portfolio behaviour in multi-level transactions, the most appropriate method of evaluating credit migration risk and sensitivity is to actually simulate such credit migration scenarios on the entire transaction or on a selected portion of Reference Entities (i.e. usually the lower rated Reference Obligations that have been subject to heavy name repetition).

Ideally, an investor is aware of how different pools compare in this respect as these are the risks they are being paid to take. It is only by evaluating these sensitivities that an investor can appropriately determine the relative level of pricing between different transactions.

Rating and Pricing CDOs

It is quite possible to have two multi-level CDOs with a particular rating and somewhat different pricing. While the pricing must be considered, it must be considered in the context of potentially very different credit migration and loss profiles. The loss in market value due to credit deterioration may be far greater than the incremental increase in premium offered. Credit ratings, particularly if they are modelled to the absolute minimum level of enhancement required for such rating, may not compensate investors for this risk differential. When requested by an investor, DBRS will incorporate default and migration simulations into the overall rating process in order to provide additional information needed to evaluate such transactions. Given what DBRS has seen in the marketplace, there is concern that transactions with similar ratings are quite different with respect to migration and default risk characteristics.

CONCLUSIONS

This methodology does not purport to be a exhaustive analysis of CDOs, nor of DBRS's approach and thoughts on CDO analytics. At the same time, DBRS feels that there is a need for investors to understand some of the implicit assumptions and choices made in the modelling of CDO products. It is only through understanding these choices that investors can become comfortable with the products and the associated risk/return characteristics.

In approaching CDOs, DBRS aims to capture a reasonable view of risk and communicate that view to investors. While DBRS is not in a position to comment on pricing this potential risk, DBRS believes that contributions can be made to its understanding. In addition, given the level of uncertainty with respect to modelling assumptions and the high level of sensitivity to the large number of structural variables, a prudent yet fair approach should be undertaken in the evaluation of this asset class. In this respect, investors should understand that the modelling results are neither intrinsically correct nor incorrect. They simply reflect the assumptions of the modeller. DBRS is of the view that rating agency analysis of CDO products is only valuable to the degree that investors understand, and are comfortable with, the modelling assumptions. This methodology has attempted to communicate and explain some of DBRS's central assumptions and views pertaining to the evaluation of the CDO asset class, with the hope of providing additional transparency into DBRS's approach.

APPENDIX A: ILLUSTRATION OF A SINGLE-LEVEL CDO

Deal Overview

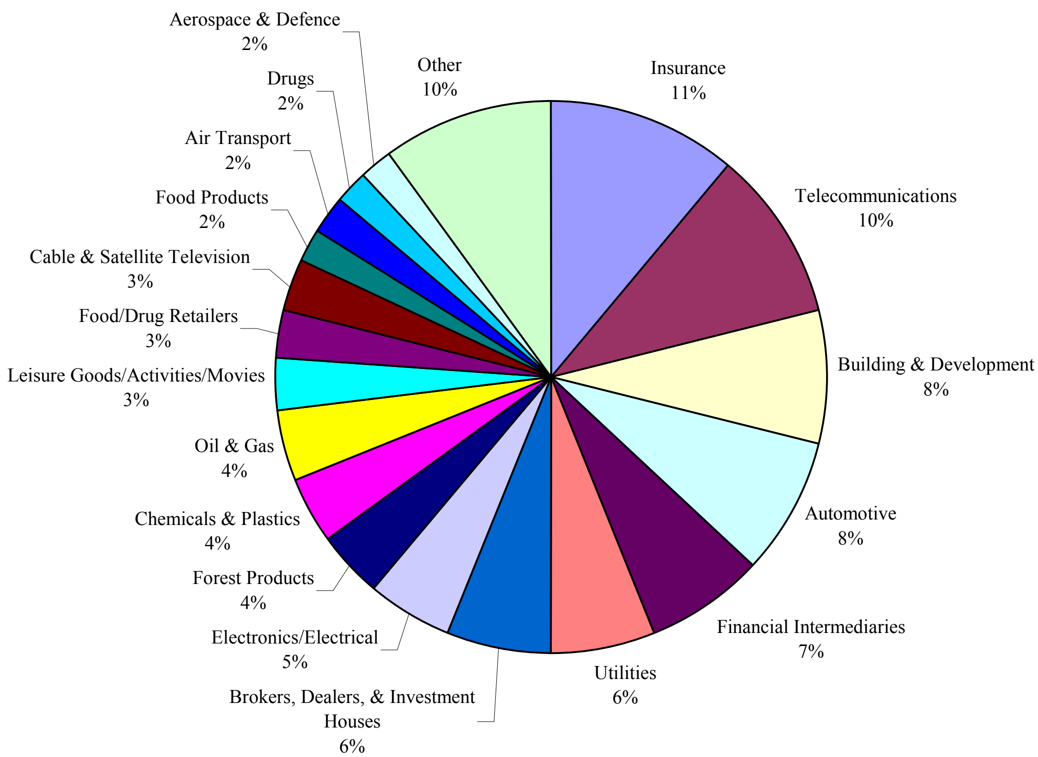
Structure

- Single-level, static, synthetic, partially funded CDO transaction.
- See Diagram 1 for a typical structure.

Transaction Characteristics

- 100 corporate names.
- Five-year tenure.
- DBRS WARF: 243/291 (after notching).
- Industry diversification: 26 of 39 industry classifications are represented.

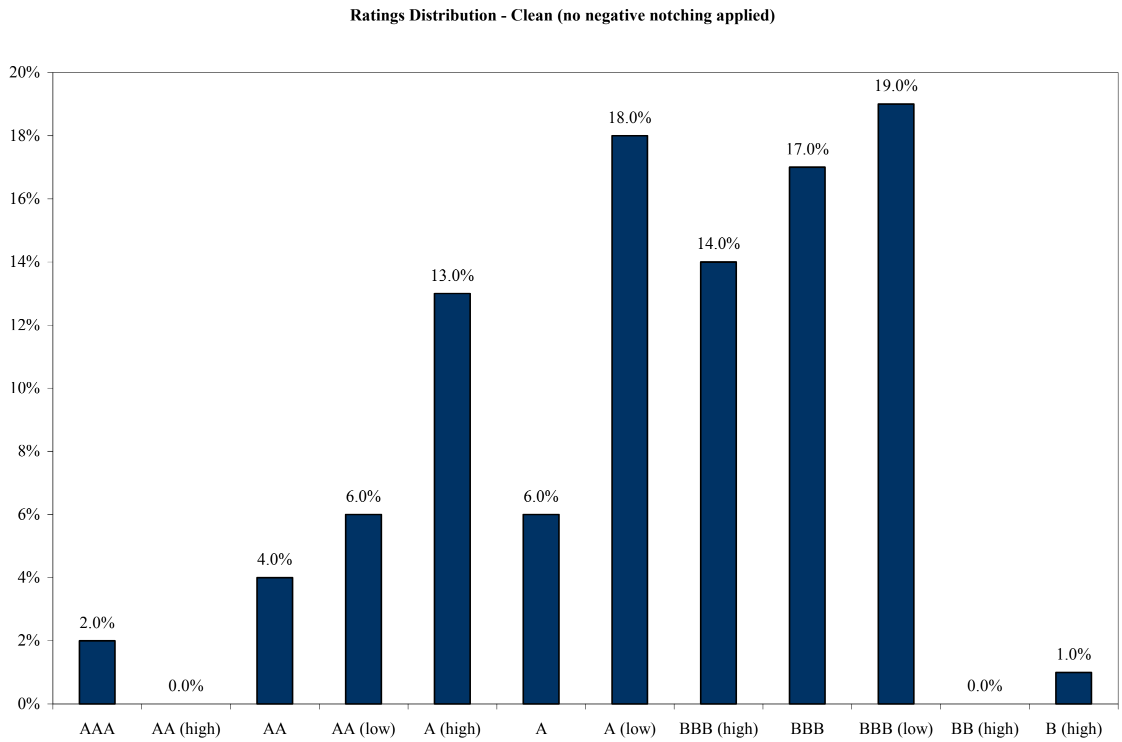
Industry Concentration

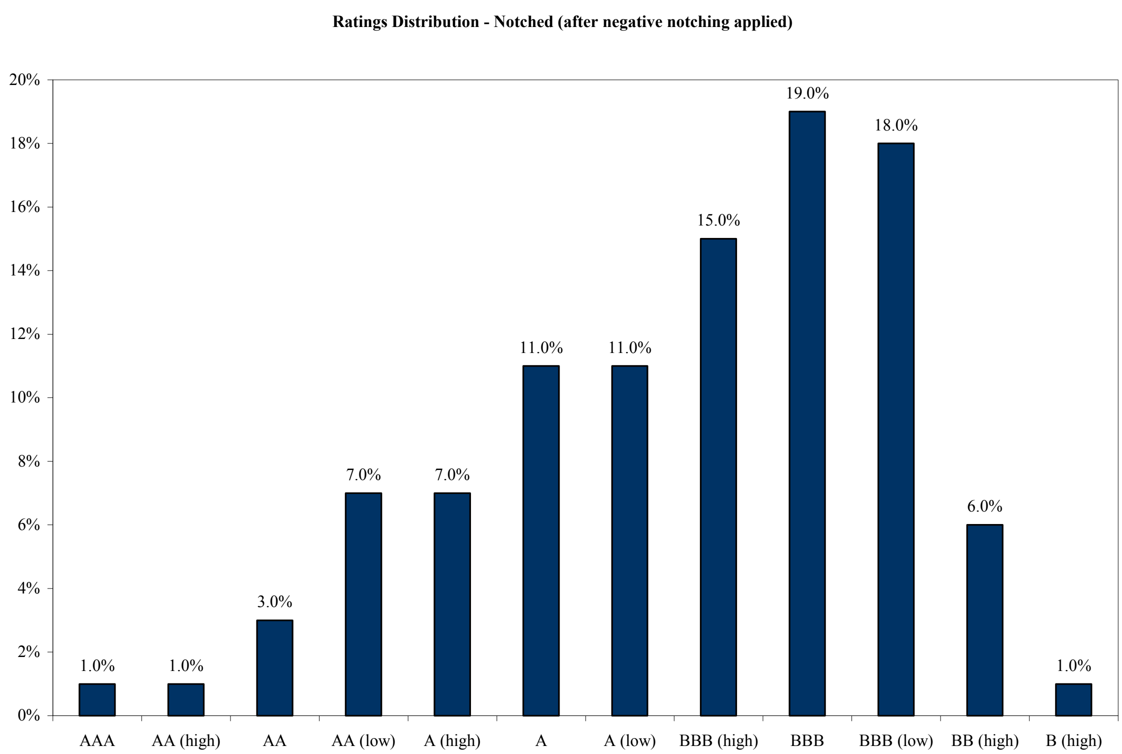


* Other constitutes remaining, low concentration industries of less than 2% each.

- Although the transaction is meant to diversify risk across many industry sectors, there are eight industries where concentrations exceed 5%.
- In particular, exposure is material in the Insurance (11%), Telecommunications (10%), and Building & Development (8%) industries.
- In order to assess the risk of concentration within those industries, a review of individual names and ratings was undertaken.
- DBRS takes the view that notwithstanding different industry classification, the Telecommunications industry is closely related to the Electronics industry; with this view, the combination of these two industries is actually closer to 15% (i.e. 10% Telecommunications plus 5% Electronics).

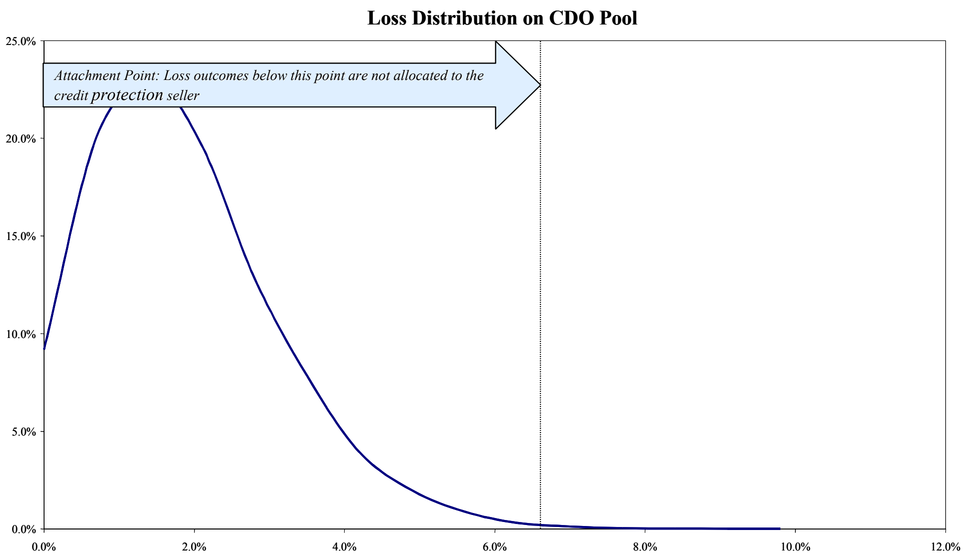
Ratings Distribution





- In both notched and un-notched cases, ratings range from AAA to B (high), representing a wide diversity of ratings.
- In the notched case, there is an observable shift to the right as the aggregate concentration of ratings below BBB (high) increases from 37% to 44%.
- Of special interest is the increase in concentration in non-investment grade ratings, from 1% to 7%, implying that concern should be focused more on those individual names.

Results



AAA Tranche Rating Requirement
By applying parameters commensurate to the AAA desired rating for a tranche, the above loss distribution was generated via the simulation process. For the five-year term, the equivalent default expectation for a typical AAA entity is 0.39% (as provided by the default curve), which implies that the level of losses that credit enhancement must cover off is 99.61%. After applying this analysis to the loss distribution, the resultant minimum requirement for a tranche to achieve a rating of AAA would be 6.60%.

AA Tranche Rating Requirement
By applying parameters commensurate to the AA desired rating for a tranche, another loss distribution (not shown) was generated via the simulation process. For the five-year term, the equivalent default expectation for a typical AA entity is 0.55% (as provided by the default curve), which implies that the level of losses that credit enhancement must cover off is 99.45%. After applying this analysis to the loss distribution, the resultant minimum requirement for a tranche to achieve a rating of AA would be 5.82%.

Sensitivity Analysis

- Having chosen the attachment point, a sensitivity analysis was run to test the resilience of this point to negative migration risk and defaults through the tenure of the deal.
- The chosen attachment point is able to withstand a downgrade of one notch at the end of the first year, and an additional notch at the end of the second year, on all credits without the need for a downgrade on the overlying security.
- In addition, one default at the end of the first year, plus an additional default at the end of the second year can occur without the need to downgrade the AAA or AA tranches.
- Both the above scenarios were arrived at via a ratings transition simulation. These cases reflect stressed migration and default outcomes conducted on the pool over the one-year and two-year horizon.
- Such sensitivity analysis allows the investor to ascertain the potential downgrade risk and overall sensitivity of the multi-level CDO.

APPENDIX B: ILLUSTRATION OF A MULTI-LEVEL CDO

Deal Overview

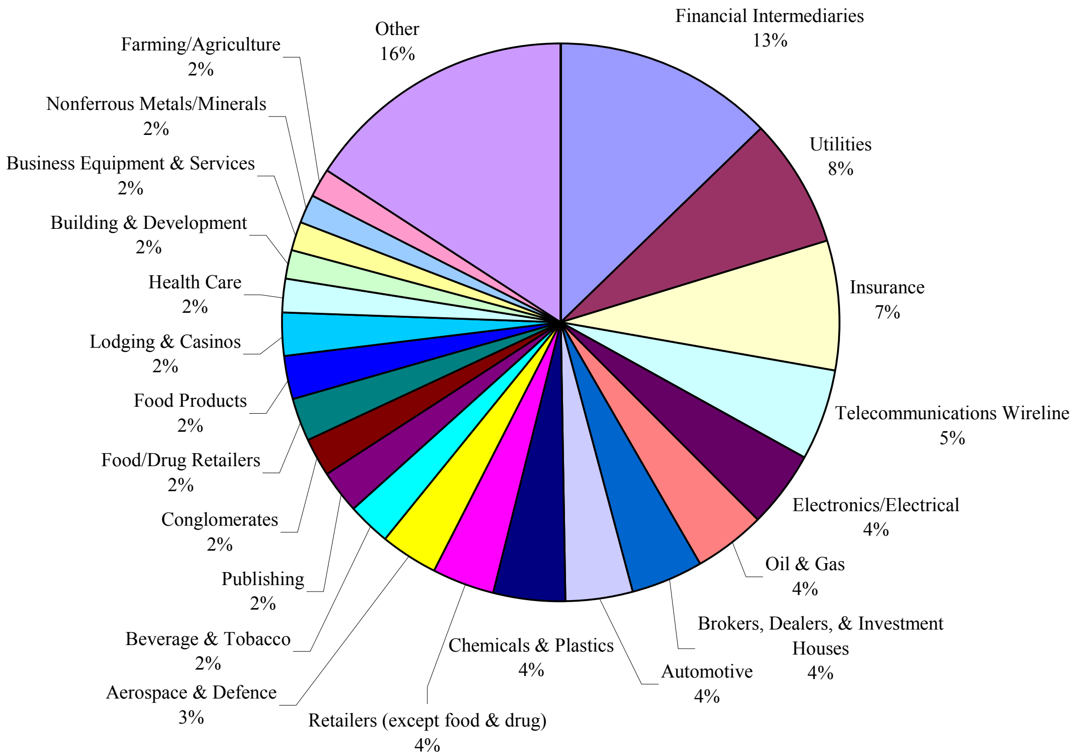
Structure

- Refer to Diagram 2.
- The multi-level CDO is comprised of ABS securities (75%) and CDO tranches (25%).

Transaction Characteristics

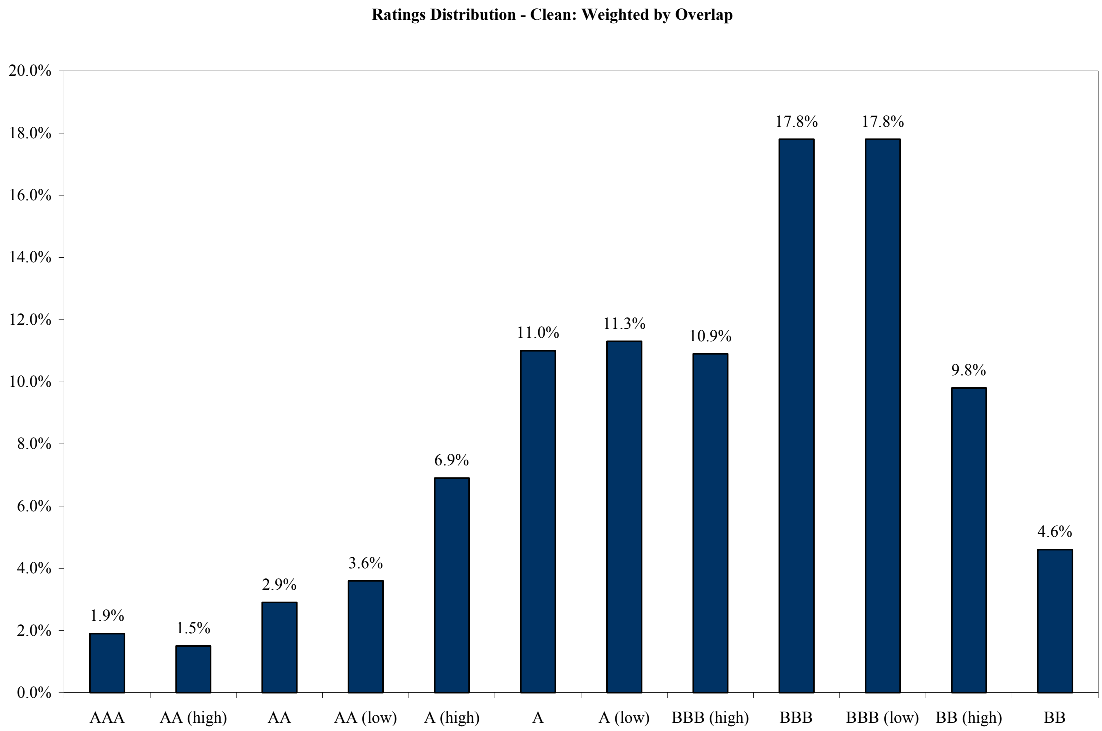
- Tenure of five years.
- 20 ABS names in total, all of which are rated AAA. Each security is weighted equally, representing 3.75% each (i.e. 75%/20).
- Ten CDO tranches comprise remainder of structure. Each weighted equally, representing 2.5% of the overlying structure (i.e. 25%/10).
- Each underlying CDO comprised of 100 corporate obligations. Portfolios have approximate WARF of 350-400.
- In total, 237 unique corporate obligations are referenced in transaction, resulting in considerable name overlap.
- Each underlying CDO attaches at 6.5%, with thickness of 2%. This attachment point equates to AA rating.
- Given that each CDO comprises 2.5% of overlying structure, explicit leverage of 1.25x results (i.e. 2.5%/2.0%).

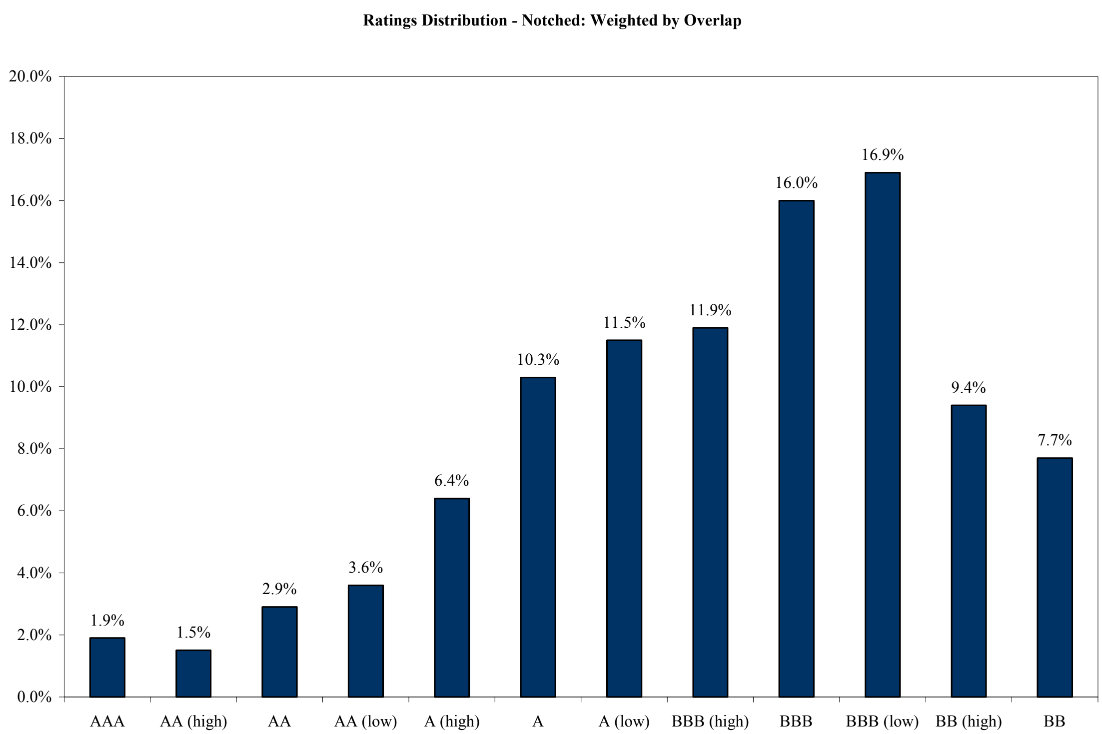
Industry Concentration



- The transaction has exposure to a number of different industries; however, several industries have material weighting. Financial Intermediaries, Utilities, Insurance, and Telecommunications represent the greatest industry concentration.
- To gain comfort on overweight industries, a review of individual names and ratings was undertaken.
- In addition, industry concentration was reviewed at a macro level to assess correlations across industries. In DBRS's view, the Telecommunications and Electronics combination is closer to 9% (i.e. 5% Telecommunications plus 4% Electronics).

Ratings Distribution





- The transaction has diverse spread of underlying corporate ratings. There is significant exposure to securities in the BBB range.
- Analysis of ratings distribution was completed on both clean and notched basis. Notching shifts distribution to the right (i.e. towards lower-grade credits).
- Notching significantly increases the exposure of the deal to non-investment grade obligations from 13% to 17%.
- Non-investment grade credits were evaluated with greater scrutiny, as such credits have the potential to impact the risk profile of the transaction.

Name Overlap

Name Overlap by Rating Category: Clean Ratings

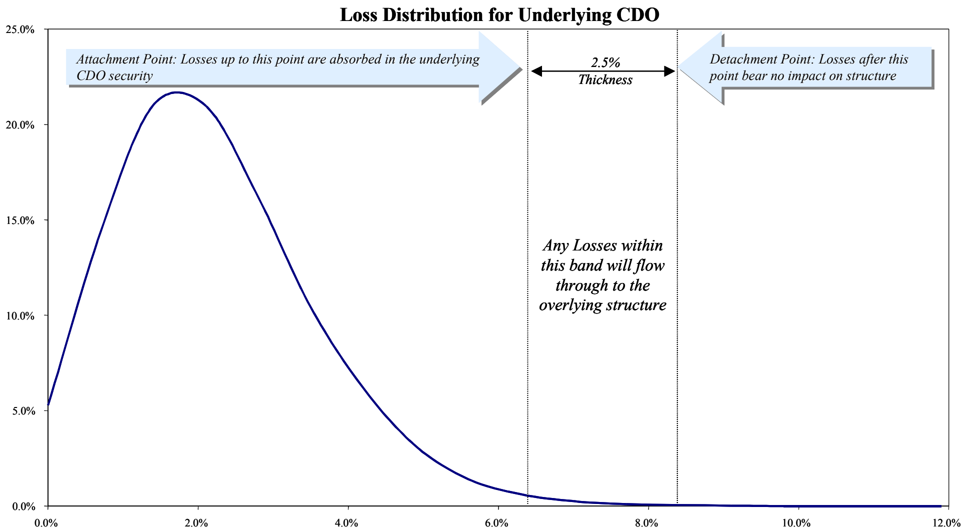
	Number of Underlying CDOs Obligation is Referenced In								
Obligor Rating	1	2	3	4	5	6	7	8	Grand Total
AAA	0.1%	0.2%			1.0%	0.6%			**1.9%**
AA (high)							0.7%	0.8%	**1.5%**
AA		0.4%		0.4%			2.1%		**2.9%**
AA (low)	0.3%	0.6%	0.3%			2.4%			**3.6%**
A (high)	0.4%	0.2%	0.6%	0.4%	1.0%	3.6%	0.7%		**6.9%**
A	0.7%	1.0%	2.4%	0.4%	3.0%	0.6%	2.1%	0.8%	**11.0%**
A (low)	1.1%	1.0%	0.9%	0.8%	2.5%	3.6%	1.4%		**11.3%**
BBB (high)	0.7%	0.8%	1.2%	1.2%	1.5%	1.2%	3.5%	0.8%	**10.9%**
BBB	0.4%	0.6%	2.1%	1.2%	1.5%	4.8%	5.6%	1.6%	**17.8%**
BBB (low)	0.3%	1.2%	1.5%	1.6%	1.0%	7.2%	4.2%	0.8%	**17.8%**
BB (high)	0.1%					5.4%	3.5%	0.8%	**9.8%**
BB			0.3%	0.4%		1.8%	2.1%		**4.6%**
Grand Total	**4.1%**	**6.0%**	**9.3%**	**6.4%**	**11.5%**	**31.2%**	**25.9%**	**5.6%**	**100.0%**

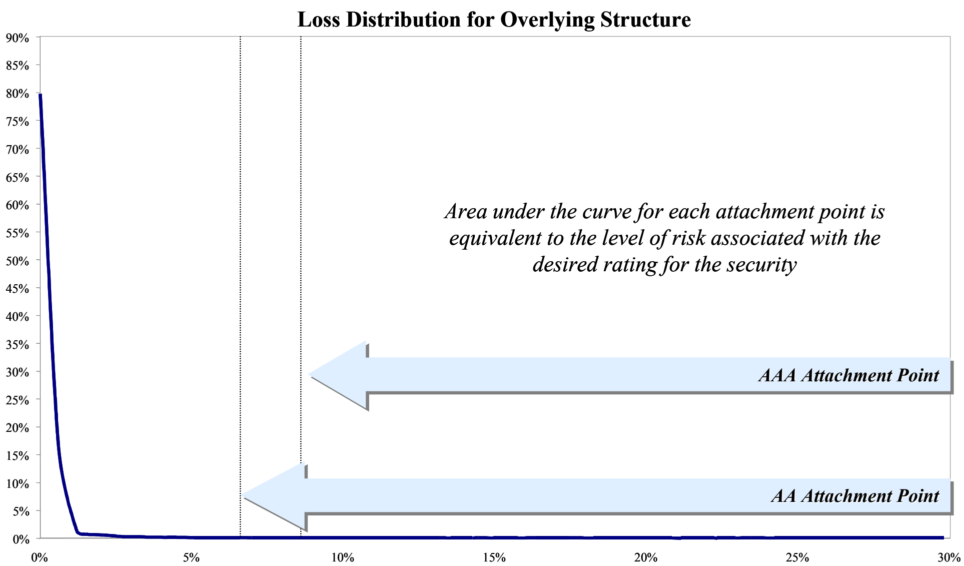
Name Overlap by Rating Category: Notched Ratings

	Number of Underlying CDOs Obligation is Referenced In								
Obligor Rating	1	2	3	4	5	6	7	8	Grand Total
AAA	0.1%	0.2%			1.0%	0.6%			**1.9%**
AA (high)							0.7%	0.8%	**1.5%**
AA		0.4%		0.4%			2.1%		**2.9%**
AA (low)	0.3%	0.6%	0.3%			2.4%			**3.6%**
A (high)	0.4%	0.2%	0.6%	0.4%	0.5%	3.6%	0.7%		**6.4%**
A	0.7%	1.0%	2.4%	0.4%	3.0%	0.6%	1.4%	0.8%	**10.3%**
A (low)	1.1%	1.0%	0.9%	0.4%	3.0%	3.0%	2.1%		**11.5%**
BBB (high)	0.7%	0.8%	1.2%	1.6%	1.5%	1.8%	3.5%	0.8%	**11.9%**
BBB	0.3%	0.6%	2.1%	0.8%	1.5%	4.2%	4.9%	1.6%	**16.0%**
BBB (low)	0.4%	1.2%	0.6%	1.6%	1.0%	7.8%	3.5%	0.8%	**16.9%**
BB (high)	0.1%		0.9%	0.4%		3.0%	4.2%	0.8%	**9.4%**
BB			0.3%	0.4%		4.2%	2.8%		**7.7%**
Grand Total	**4.1%**	**6.0%**	**9.3%**	**6.4%**	**11.5%**	**31.2%**	**25.9%**	**5.6%**	**100.0%**

- Material overlap exists.
- Exposure was calculated on a dollar-weighted basis.
- Approximately 32% of corporate obligations appear in the overlying structure seven plus times. These highly overlapped names are concentrated in the BBB to BB (high) range.
- Name overlaps in the lower rating category were subject to greater attention, since they have the greatest potential to cause deterioration or negative credit migration.

Results





Tranche Rating Requirement

Simulations were run on each of the underlying corporate obligations, in addition to the ABS securities, to generate a loss distribution for the transaction. Each underlying CDO has its own loss distribution as a result of the simulations. However, losses from these simulations only impact the overlying structure when they exceed the given underlying attachment point. As discussed earlier, losses stop flowing to the overlying structure when they exceed the detachment point. The aggregation of these losses in conjunction with the ABS securities creates the loss distribution for the overlying security. The attachment point on the overlying security was selected such that it provides a level of protection to investors that is commensurate to their desired rating level. In other words, the AAA attachment point leaves the investor with risk that is generally equivalent to holding a AAA security. The AAA and AA attachment points are highlighted in the charts above.

Sensitivity Analysis

- Having chosen the attachment point, a sensitivity analysis was run to test the resilience of this point to negative migration risk and defaults through the tenure of the deal.
- The chosen attachment point is able to withstand a downgrade of one notch at the end of the first year, and an additional notch at the end of the second year, on names that are overlapped seven or more times without the need for a downgrade on the overlying security.
- In addition, one default at the end of the first year, plus an additional default at the end of the second year can occur without the need to downgrade the AAA or AA tranches.
- The above sensitivities were conducted on credits that are overlapped seven or more times.
- Both scenarios were arrived at via ratings transition simulation. These cases reflect stressed migration and default outcomes conducted on the pool over the one-year and two-year horizon.
- Such sensitivity analyses enable the investor to ascertain the potential downgrade risk and overall sensitivity of the multi-level CDO.