

# Understanding the Benefits and Risks of Synthetic Collateralized Debt Obligations

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**F**inancial technology supporting the field of “structured finance” has developed rapidly since the mid-1990s. The key financial instrument to emerge is the collateralized debt obligation (CDO). Structured finance instruments, such as CDOs, can be defined by three key characteristics: (i) pooling of assets; (ii) creating tranches of liabilities backed by the asset pool and having different levels of risk; and (iii) delinking of the credit risk of the collateral asset pool from the credit risk of the originator (BIS 2005).

It is estimated that, in 2003, total global issuance of CDOs and other asset-backed securities stood at about US\$1.4 trillion, compared with less than US\$300 billion in 1997 (BIS 2005, 17). A growing proportion of this market is represented by the new generation of “synthetic” CDOs, which transfer risk through pools of credit derivatives contracts rather than through portfolios of securities.

From the perspective of financial stability, the rapid growth, unique features, and growing complexity of these instruments raise some interesting issues. This article highlights the positive contribution that CDOs make to the efficiency of the financial system as new instruments that help to complete markets. However, the article also points out that these instruments represent new and novel risks for investors. Assessing and pricing the risks in these structures requires complex models, whose results are highly sensitive to certain assumptions, and concerns about “model risk” are explored.

In Canada, the large banks have been actively involved in the creation and distribution of these products through their global investment banking arms. Globally, CDOs are increasingly attracting the interest of institutional investors, such as insurance companies, pension funds, and hedge funds, because their yields are superior

to those of conventional fixed-income instruments, and their various tranches can offer investors unique risk/return combinations. Canadian institutional investors have only recently started to use these instruments, but this is expected to increase rapidly.

## The Origins of the CDO: A Special Class of Asset-Backed Security

In Canada and globally, securitization has become a mainstream source of financing for corporations over the past 15 years. The essence of the securitization technique is the transfer of a pool of assets or credits—and the credit risk entailed—from an originating institution into a stand-alone, special-purpose vehicle with a finite life. The institution then sells one or more tranches of asset-backed securities (ABSs) to investors to fund the purchase of the assets.

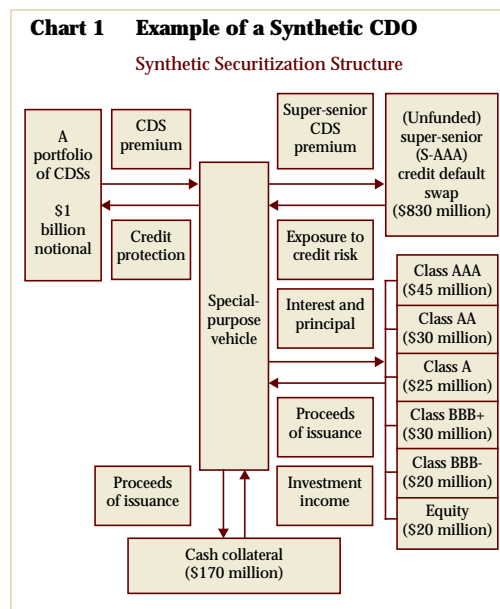
The motivation for tranching is to create at least one class of securities or notes—often referred to as the senior tranche—whose credit rating is higher than the average rating of the pool of assets. In addition, there is typically a subordinated or junior tranche, which provides credit enhancement and absorbs most or all of the pool’s expected losses.

In traditional securitizations, the assets in the pool tend to be relatively homogeneous (for example, household loans, such as residential mortgages and credit card loans), and the number of tranches on the liability side tends to be small, usually comprising just the senior and subordinated tranches. The relative homogeneity of the asset pool permits credit risk in these pools (i.e., the expected losses) to be estimated with relatively reliable statistical techniques based on the “law of large numbers.” The assets in the pool are segregated—typically in a trust

arrangement—to secure the ABS, and they are understood to be insulated from and independent of the affairs of the firm or firms that originated and sold the assets.

Structured finance instruments such as CDOs, which transfer the credit risk on a reference pool of assets to tranche investors, while conceptually similar to traditional securitizations, are quite different in certain respects. First, the pools of assets or credits tend to be quite heterogeneous, having much more complex credit-risk properties than the pools underlying basic securitizations. (See Chart 1 for an example.) Second, these credits tend to be mainly corporate in nature, such as corporate bonds, loans, or single-name credit default swaps. Third, with respect to the liabilities, there are often many more tranches than for a traditional securitization. These typically include a AAA-rated senior tranche (and possibly a super-senior tranche), one or more lower-rated mezzanine and subordinated tranches, and an unrated junior or “equity” tranche.

Drawing heavily on their traditional securitization origins, the first generation of CDOs were typically “cash” CDOs. This is because the assets in the pool were cash securities, such as bonds and loans, rather than synthetic ones, such as credit default swaps (CDSs), which are derived from underlying cash securities.<sup>1</sup> Cash CDOs were structured primarily as “balance-sheet CDOs,” which tended to be initiated by financial institutions, such as banks and, to a lesser extent, by non-financial corporations that wished to sell their own assets or transfer some of the risks inherent in these assets. The transactions were motivated by the desire to reduce the balance sheet, obtain cheaper funding, improve liquidity, or (in the case of regulated financial institutions) reduce regulatory capital requirements. Transferring some of the risks in a loan portfolio to a CDO structure (or through other risk-transfer instruments) to obtain capital relief is sometimes referred to as regulatory arbitrage.<sup>2</sup>



1. These instruments were sometimes referred to as collateralized bond obligations (CBOs) and collateralized loan obligations (CLOs), depending on the nature of the collateral. However, since the collateral was increasingly mixed together, the structures began to be referred to generically as CDOs.
2. See Kiff and Morrow (2000) for a discussion of regulatory arbitrage.

Increasingly, however, CDO transactions were initiated as arbitrage CDOs, where the CDO vehicle acquires assets in the open market, rather than from an originating institution (Lucas 2001, 6). Arbitrage CDOs tend to be organized by asset managers and institutional investors rather than by financial institutions. The investors in the high-risk equity or first-loss tranche earn a relatively high rate of return by taking advantage of the arbitrage opportunity—the difference between the return earned on the asset pool in the CDO (adjusted for losses caused by defaults) and the interest paid to the debt holders.

## The Emergence of Synthetic CDOs

Synthetic CDOs emerged in 1997 as a refinement of cash CDOs. Cash CDOs have a reference portfolio made up of cash assets, such as corporate loans and bonds. For synthetic CDOs, the reference portfolio is made up of credit default swaps. A credit default swap allows institutions to transfer the economic risk but not the legal ownership of underlying assets. The credit default swap has rapidly developed into the largest and most liquid credit derivatives instrument in global markets. See Reid (2005) in this issue and Kiff and Morrow (2000) for more details on credit default swaps.

Thus, the synthetic CDO, invested in pools of CDSs, represents the convergence of two financial technologies: securitization and credit derivatives (Chart 1). Through the CDO vehicle, the individual counterparties of the CDS contracts in the asset pool essentially buy protection. In exchange for this protection, the CDO receives a stream of premium payments—analogueous to the interest payments it would have received on a cash CDO—and passes them through to the tranche investors in the CDO. The CDO thus effectively buys protection from these investors.

Because funds raised from investors in the various synthetic CDO tranches are not used to purchase loans or bonds (since exposures are instead being acquired through credit default swap contracts) they are typically invested in a cash collateral account of risk-free liquid assets, such as government bonds. This risk-free pool is there to absorb losses on the CDS reference portfolio, as well as to provide investment income. The premiums earned on the credit

default swaps are analogueous to the spreads over the risk-free rate that would have been earned on a pool of corporate loans or bonds.

Note that in Chart 1 the structure also has an unfunded super-senior tranche—a feature of many synthetic CDOs. Investors in this tranche do not put up cash but instead are paid a premium to enter into a credit default swap with the CDO. Thus, a “synthetic liability” has been created that is analogueous to the synthetic assets in the pool. This tranche, which has only the most remote chance of experiencing a credit loss (equity, mezzanine, and AAA tranches would have to be exhausted first), is paid a spread (premium) that is compressed even lower than that which a AAA investor would earn.<sup>3</sup>

Why the trend to synthetic instead of cash structures? Through the CDS market, synthetic structures typically have access to a more diverse range of credits than cash structures. Credit default swaps can theoretically be written in any amount with respect to any issuer (corporate or sovereign) that has issued debt instruments, such as bonds or loans. Thus, synthetic structures tend to facilitate greater portfolio diversification (Tavakoli 2003, 8).<sup>4</sup>

On the liability side, the super-senior tranche (which, with its “AAA plus” credit rating, has no counterpart in the world of cash securities) results in very cost-effective financing costs for the CDO. This tranche typically represents a very large percentage of the par value of the liabilities; for example, in the structure in Chart 1, it accounts for \$830 million of the \$1 billion issue. The larger the super-senior tranche, the greater the effective leverage of the structure.<sup>5</sup>

## Credit-Protection Structures

An important part of the “risk-proofing” of CDOs—both cash and synthetic—is their credit-protection structure. In terms of their credit structure, CDOs may be classified either as cash

3. The super-senior investor is generally perceived as providing protection to the CDO against only the most extreme systemic event.
4. This can also lead to more favourable ratings from the credit-rating agencies for a given pool.
5. The counterparty to the CDO on these super-senior transactions is often a AAA-rated “monoline” insurance company. Such insurance firms specialize in providing guarantees of this type.

flow or market value. This distinction refers to the mechanisms by which the structure protects debt holders from credit losses.

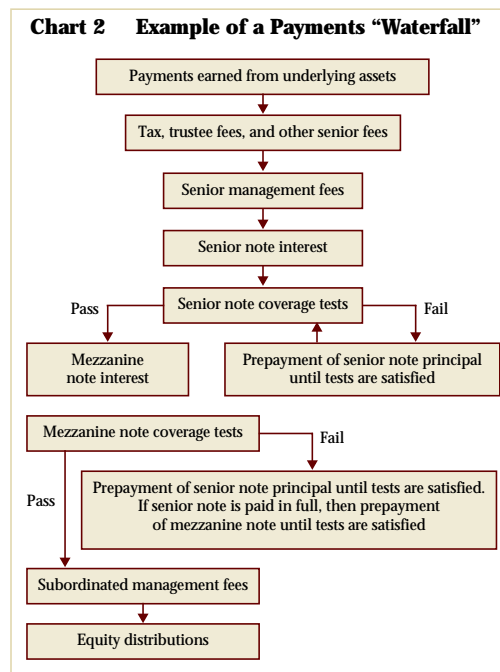
The most common structure is cash flow. Here, the objective of the CDO manager is to generate cash flow for the senior or mezzanine tranches without the need to actively trade the credits in the asset pool. In fact, trading in these structures tends to be severely restricted. Cash flow from the pool (interest and premiums, as well as principal) after estimated credit losses is judged to be sufficient to pay the tranche investors.

Payments earned from the underlying assets in the pool are distributed in a strict order of priority (determined in detailed transaction-specific documentation) often referred to as a “waterfall.” Chart 2 presents a simplified example of this payments distribution. Typically, the fees of the asset managers and trustees are paid first. Then, interest owed to the senior debt holders is paid. At that point, two broad types of coverage tests usually take place. The first is a *par value test*. Typically, the par value of collateral must exceed the value of the debt by a certain percentage called a trigger point. The second test is an *interest coverage test* to determine whether a certain minimum ratio of interest earned to interest paid out is being maintained. If the CDO passes these tests, cash continues to flow down to the less-senior debt holders. However, if one or both tests fail, cash payments are diverted to pay off the senior holders until the required covenant ratios are restored.

In contrast, market-value structures depend on the ability of the CDO manager to generate a sufficient return on the market value of the collateral. Coverage tests are also conducted regularly for these structures. But they are based on the market value of the portfolio rather than on the par value, as is the case for cash-flow structures.

## What Happens When a Credit Event Occurs?

When there is a “credit event,” such as a default or rating downgrade, with respect to one or more credits in the reference portfolio, the trustee withdraws sufficient funds from the cash collateral account to compensate the protection buyers (i.e., the counterparties on the credit default swaps) for their losses. Credit support is “layered.” The equity/first-loss tranche absorbs



initial losses, followed by the mezzanine tranches, which absorb some additional losses, and lastly by the senior and super-senior tranches. These last two tranches are expected to be insulated from losses except under the most extreme circumstances.

## How Does a CDO Create Value?

Why do CDOs exist, and why do investors buy them when it appears, at first glance, that all they do is re-package existing credit-risk instruments and transform them into different payment structures? The economic value or surplus generated by a CDO is evidenced by the fact that spread income from the reference portfolio can compensate investors in the CDO tranches and also pay structuring and asset-management fees (BIS 2004). For the economics of a CDO to work, the weighted average return on the credits in the pool minus the weighted average cost of all liabilities, expenses associated with arranging the CDO, and expected credit losses must be positive, and also sufficiently positive to attract equity investors.<sup>6</sup>

There are various explanations of how CDOs generate value. These are related to both the asset side and the liability side of the CDO structure. We first examine the asset side.

For balance-sheet CDOs, an important part of the explanation has been the opportunity for regulatory capital arbitrage (see page 54). But this factor is becoming increasingly less important and will largely disappear with the implementation of Basel II in 2007.<sup>7</sup> CDOs also try to take advantage of arbitrage opportunities arising from market segmentation. For example, it has been observed that the spread differentials on certain ratings categories of cash securities and CDSs may sometimes be higher than warranted by expected loss (BIS 2005; Ashcraft 2005). CDOs can accumulate those assets and issue tranches against them, which would pay the normal market spread. The excess spread would be incremental value, which would go to the equity investors in such CDOs.

6. Recall that equity investors have the right to this residual return after all other debt holders are paid.
7. A prime objective of the Basel II agreement from its inception has been to eliminate such arbitrage opportunities.

In addition, CDOs help investors overcome market imperfections associated with the illiquidity of the markets for bonds, loans, and credit default swaps (Gibson 2004). Most corporate bonds trade infrequently and loans even less so. CDS markets may now, in some cases, be more liquid than the underlying cash markets. It is generally acknowledged that the aggregate cost of creating a large CDO by a specialist asset-management firm or investment bank is significantly less than that of investors individually paying high bid/ask spreads in these markets in order to assemble individual portfolios that meet their risk/return payoffs.

More value-added is derived from the process of creating multiple tranches on the liability side. In its simplest form, a CDO basically serves the purpose of carving up the aggregate credit portfolio into various tranches, each with their own risk/return characteristics. This tranching creates unique opportunities for investors interested in engaging in CDO transactions at risk/return levels in line with their particular appetites and preferences (Adams, Jhooty, and Wong 2004, 12). Also, pooling and tranching may serve to mitigate asymmetric information and incentive problems that might exist in other forms of credit-risk transfer (Mitchell 2004).

Thus, it is argued that CDOs serve to complete markets; that is, they synthesize combinations of risk and return that did not exist previously. By pooling and tranching, borrowers or risk shedders—represented in the pool of cash assets or credit default swaps—get access to financing or risk transfer from investors to whom they would not normally have access. For example, an institutional investor may want exposure to a certain sector—say, high-yield bonds, which, in the cash markets, are always non-investment grade—but is constrained under its investment guidelines to buying investment-grade bonds. That investor can participate in the senior (AAA) tranche of a CDO of high-yield bonds.

## Assessing the Risks of CDOs

Any very successful financial innovation, such as the CDO, will normally offer important benefits to various economic agents. The benefits are usually evident, but the risks are more subtle and require thorough analysis.

Ratings agencies typically go through a two-step process in reviewing the risks of a CDO

structure for the purpose of determining a rating, which, in turn, determines the tranche pricing (Fender and Kiff 2004). In the first stage, analytic models are used to determine the risk in the underlying pool of assets. This involves “default risk,” essentially estimating the distribution of potential credit losses in the pool. The second stage is the process of structural analysis, which involves understanding the “non-default” risks arising from the CDO’s structure. It is this structure that transforms the credit risk embodied in the pool of assets into a distinct set of risk characteristics on the liability or tranching side. This analysis involves a detailed understanding of the “payments waterfall” (Chart 2) and requires the accurate modelling of the distribution of cash flows from the asset pool to the various tranche holders.<sup>8</sup>

### **Modelling Credit Risk: Assessing the Risk in the Asset Pool**

In the first stage of the analysis, the main factors that the ratings agencies use to determine the expected credit-loss distribution of a portfolio are estimates of: (i) probabilities of default (PDs) of the individual obligors in the pool and how these vary over the life of the transaction; (ii) recovery rates or losses-given-default (LGD); and (iii) default correlations within the pool, which determine the tendency of multiple defaults to occur within a given time (BIS 2005, 21). Credit-risk modelling (using Monte Carlo simulations) transforms assumptions about PDs, recovery rates, and correlations into an overall assessment of an asset pool’s credit quality.

In addition to the expected losses of CDOs, “unexpected loss” or loss volatility can be substantial and is driven mainly by two factors: single-credit concentration and, again, default correlation. Concentration (i.e., the lumpiness of the portfolio) is linked to idiosyncratic risks. The greater the concentration, the more the portfolio is exposed to idiosyncratic risk. Default correlation, on the other hand, relates to systematic risk and reflects the sensitivity of PDs to common factors and, therefore, individual obligors’ exposure to undiversifiable or business-cycle

risks. It is vital to note that the estimated loss distributions of a portfolio—expected and unexpected—are highly sensitive to assumptions about default correlation.

Because of the complexity of the transactions, the rating and pricing of CDOs necessarily involve “model risk.” Each of the three major global rating agencies—Standard & Poor’s, Moody’s, and Fitch Ratings—deals with this in broadly similar but different ways. Fender and Kiff (2004) recently reviewed this issue, documenting some of the key features of the models used by the rating agencies to evaluate the credit risk of CDO collateral pools and how differences in model specifics can influence the credit-risk assessment of individual pool tranches. The study shows that the use of different modelling approaches may, in theory, lead to different rating outcomes for individual tranches, particularly when differences in correlation assumptions are taken into account.

Their work also highlights the importance of correlation assumptions for estimating expected losses and, potentially, CDO tranche ratings. Getting these assumptions right is, therefore, one of the key challenges for the rating agencies in dealing with pooled credit risk and is critical for ratings accuracy. The authors find that differences in correlation assumptions and modelling approaches, when combined, can lead to meaningful differences in tranche ratings, unless compensated for by differences in other parts of the rating process. See Box 1 for an example.

The authors suggest that the resulting model risk needs to be understood by investors and argue against exclusive reliance on CDO ratings in taking investment decisions. In addition, continuing investor demand for more than one rating per tranche may be justified to help avoid inappropriate risk-adjusted returns.

### **Involvement by Canadian Institutions**

The large Canadian banks have been actively involved in the creation and distribution of these products through their global investment banking arms. However, Canadian institutional investors have only recently started to invest in these instruments. Their participation is expected to rise rapidly in the next few years, as investor interest in alternative asset classes accelerates.

8. Other structural risks assessed by the ratings agencies include risks associated with third-party participants in the CDOs, as well as legal and documentation risk.

## Box 1

## The Importance of the Correlation Assumption to CDO Credit Ratings

The accompanying chart shows the various potential loss distributions that underlie a typical CDO. In this case, the underlying exposure consists of a diversified portfolio of five-year credit default swaps referenced to 120 investment-grade (rated AAA to BBB) obligors with an average rating of A. Using Standard & Poor's (S&P) rating methodology, a five-year senior tranche rated AA- can be issued off of this pool if at least 4.1 per cent of all of the underlying portfolio's losses are absorbed by less-senior tranches.

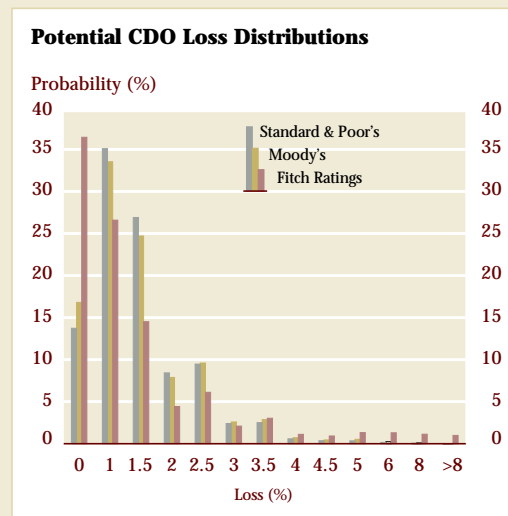
These losses can be viewed as "potential" loss distributions, because their shapes are driven by different assumptions regarding the default correlations between the 120 CDSs. For instance, S&P assumes a very high correlation between the defaults of obligors that are in the same industry sector, but zero correlation across sectors. Moody's, on the other hand, typically assumes a slightly lower intra-sector correlation and a non-zero but low inter-sector correlation.<sup>1</sup> Fitch Ratings uses empirically driven obligor-to-obligor-specific correlations, which tend to be higher than those used by S&P and Moody's.

As the chart shows, the correlation assumptions have an important impact on the shape of the potential loss distributions. That is, the tail is thickest for the higher-correlation Fitch assumption, relative to those associated with the lower-correlation Moody's and S&P assumptions. The thickness of the tails is important to the senior tranche ratings, because they are most vulnerable to these extreme losses, i.e., the scenarios where total losses exceed 4.1 per cent.

Using S&P's correlation assumptions, the senior tranche's probability of default (PD) works out to around 0.9 per cent, which is the same PD associated with a five-year, AA- corporate bond. Hence, the tranche is rated AA- by S&P. However, if the heaviest Moody's correlation

assumption is used, the senior tranche's PD works out to about 1.3 per cent, which would map into an A- corporate bond rating. The Fitch correlation assumption is high enough that it could actually map into a subinvestment-grade rating (below BBB-).

Of course, there is more to rating a CDO tranche than just analyzing loss distributions, but the example highlights the potential significance of just one key quantitative parameter.<sup>2</sup>



1. For more details on the correlation assumptions, see Fender and Kiff (2004). Essentially, the default correlations are driven by assumptions regarding the correlations of the asset side of the balance sheets of the underlying corporate obligors.

2. More details on other dimensions of the CDO rating process can be found in Fender and Kiff (2004).

A more recent development has been the offering to retail investors of CDO-like income trusts.<sup>9</sup> For example, in November 2004, RBC Dominion Securities issued an \$85 million offering of “Global DiSCS Trust 2004-1” retail-targeted investment trust units. In August 2004, National Bank Financial and CIBC World Markets led an offering of \$100 million of “Global DIGIT” investment trust units. In both cases, very highly rated tranches were created from large pools of diversified fixed-income securities and credit default swaps. These were somewhat different from traditional CDOs, in that there were effectively only two tranches: a senior and equity tranche. But the motivations and the nature of the pools made them more like CDOs than traditional securitizations.

The credit ratings of such investment trusts can also be quite sensitive to model and parameter assumptions. While this would be well understood by typical institutional CDO investors, many retail investors, to whom these securities are being targeted, may not fully understand the risks inherent in these instruments. In addition, these structures appear to have been rated by only one rating agency, whereas it would seem prudent to have a second opinion for all investors but especially for retail ones.

## Conclusions

Developments in structured finance since the late 1990s have been impressive; the myriad forms of CDOs—which pool and tranche risks—seem to be beneficial from the point of view of completing markets. But these structures entail complex risks, and the models the rating agencies use to price them are also very complex. It is incumbent upon all types of investors to understand the model risk inherent to these instruments and to require more than one rating service for their risk assessment.

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9. See King (2003) for more detail on income trusts.



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