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# **Credit Risk Transfer**

*Developments from 2005 to 2007*

July 2008



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# Credit Risk Transfer

## Summary

Credit risk transfer has grown quickly, often with complex products, and provides concrete benefits to the global financial system. The benefits of credit risk transfer (CRT) are well understood and have not changed since the Joint Forum's first CRT report in 2005. CRT allows credit risk to be more easily transferred and potentially more widely dispersed across the financial market. CRT has made the market pricing of credit risk more liquid and transparent. But CRT also poses new risks. A failure to understand and manage some of these risks contributed to the market turmoil of 2007.

Like the Joint Forum's 2005 report, this report focuses on the newest forms of credit risk transfer, those associated with credit derivatives. These new forms of CRT were the impetus for the 2005 report, and their continued evolution and growth motivated this update.

Several developments in CRT markets are important for understanding the evolving risks of CRT and the role of CRT in the market turmoil of 2007. Since 2005, CRT activity has become significant in two new underlying asset classes: asset-backed securities (ABS) and leveraged loans. Investor demand for tranching CRT products, such as collateralised debt obligations referencing ABS (ABS CDOs) and collateralised loan obligations (CLOs), was high. This demand encouraged significant origination and issuance of products in these underlying asset classes. ABS CDOs focused their portfolios on US subprime residential mortgage-backed securities (RMBS), while CLOs focused their portfolios on leveraged loans sourced from corporate mergers and acquisitions and leveraged buyouts.

Across all CRT asset classes, the growth of indexes since 2005 is an important development. Indexes now represent more than half of all credit derivatives outstanding, up from virtually nothing in 2004. Indexes are widely used to trade investment-grade corporate credit risk across the major markets (North America, Europe and Asia). Indexes also have been created in the ABS and leveraged loan markets, the ABX and LCDX, respectively. In each of these markets, indexes provide a relatively liquid and transparent source of pricing, though the corporate indexes are much more liquid than the indexes in other market segments. Market participants have come to view the credit derivative indexes as a key source of pricing information on these markets. The liquidity and price transparency that indexes provide has enabled credit risk to become a traded asset class.

The 2005 report noted the growing complexity of CRT products, and this trend has continued. The 2005 report discussed in some detail the complex risks of CDOs, with a particular focus on investment-grade corporate CDOs. This report focuses to a significant degree on ABS CDOs, which are an order of magnitude more complex than investment-grade corporate CDOs, since their collateral pool consists of a portfolio of ABS. Each of these ABS is itself a tranche of a securitisation whose underlying collateral is a pool of hundreds or thousands of individual credit assets. Referring to this complexity, one market participant described ABS CDOs as "model risk squared."

At the same time that CRT products have become more complex, the investors in CRT have grown more diverse and global. More market participants have become comfortable investing in CRT, which is an important factor explaining its growth. On balance, CRT activity has transferred credit risk out of the United States into global markets. In addition, since 2005, hedge funds have become an important force in CRT markets.

The combination of complex products and new investors has presented a business opportunity for credit rating agencies. For a number of years, rating agencies have rated CRT products, using the same letter ratings (AAA, AA and so on) originally developed for rating corporate bonds. Riding the wave of growth of CRT, in recent years structured finance securities have contributed a growing share of the earnings of rating agencies.

All these factors together set the stage for the market turmoil of 2007. Market discipline had been weak as investors in ABS CDOs failed to adequately look through complex CRT structures to the underlying risks of the subprime mortgage market that they were taking on. In some cases, investors were too willing to rely solely on credit ratings as a risk assessment tool. Originators saw little incentive, financial or reputational, to monitor the quality of subprime mortgages that could be sold so easily into the securitisation market. When the subprime mortgage market came under stress due to weakening house prices, investors in ABS CDOs became aware that they were also at risk.

One of the reputed benefits of the CRT market is its ability to spread credit risk to a wide range of market participants who are willing and able to bear it. For the riskier, more junior tranches of ABS CDOs, this appears to have happened. Many of these investors have taken losses without material knock-on effects to wider markets.

But the same cannot be said of the investors in senior tranches. Three main categories of market participants bore the bulk of the senior tranche risk over 2005–07: (1) conduits that funded their CRT investments by issuing short-term commercial paper, (2) monoline financial guarantors, and (3) CDO underwriters that retained the super-senior risk after selling the riskier tranches. All three have come under stress, transmitting the initial subprime shock to the broader financial markets.

The market turmoil spread because of risk management failures at several large banks and securities firms. Some firms took assets on their balance sheets or extended credit to off-balance-sheet entities, even though they had no contractual obligation to do so. In some cases firms did this for reputational reasons. Few firms had anticipated this strain on their balance sheet liquidity. Underwriters of ABS CDOs who had retained super-senior risk wound up taking material mark-to-market losses as the subprime crisis deepened. The complexity of some CRT positions, such as ABS CDO tranches, led to difficulties in valuation when market liquidity dried up. Correlation risk materialised in the ABS CDO market, in the form of concentrated exposures to subprime risk. And the perennial challenge of counterparty credit risk materialised from large, concentrated exposures of some firms to monoline financial guarantors.

Supervisors remain concerned about several aspects of the CRT market: complexity, valuation, as well as liquidity, operational and reputation risks, and the broader effects of the growth of CRT. To address these concerns and other issues raised in the sections below, this report concludes with recommendations directed at market participants and supervisors. Going forward, market participants and supervisors should use the recommendations in this report together with the recommendations from the 2005 report as a single package of recommendations to improve risk management, disclosure and supervisory approaches for credit risk transfer.

## **About this report**

In March 2007, the Financial Stability Forum (FSF) asked the Joint Forum to consider updating its report on Credit Risk Transfer, published in March 2005, in light of the continued rapid growth of CRT. The Joint Forum asked its Working Group on Risk Assessment and

Capital to undertake the update. While the Working Group was beginning its work in the summer of 2007, market turmoil broke out that has put the CRT market under unprecedented stress. The Working Group re-oriented its work to include issues raised by the recent market turmoil, while continuing to address the questions that motivated the FSF's original request.

The analysis in this report is based on interviews that Working Group members conducted with regulated firms in their respective jurisdictions, on meetings between a small subgroup and nearly two dozen market participants, and on a survey of Joint Forum members to identify supervisory concerns. It was released for consultation from April until May, 2008 and the final report was presented to the Joint Forum in June 2008.

This report has four parts. Part 1 consists of two sections that document the growth in CRT since the last Joint Forum report in 2005. Section 1 covers new CRT products and CRT participants, which are discussed in more detail in Appendices A and B, respectively. Section 2 addresses the often-asked question of who bears the credit risk that is transferred via CRT.

Part 2 consists of two sections that identify how CRT contributed to the recent market turmoil. Section 3 describes market-wide developments. Section 4 describes risk management challenges that CRT poses for banks and securities firms, noting some areas where risk management practices may have been lacking in the market turmoil.

Part 3 answers four questions about CRT that were posed by the Financial Stability Forum, when it requested this report, and by various supervisors. This comprises sections 5–8.

Part 4 documents the concerns that supervisors have about CRT (in section 9) and makes recommendations for market participants and supervisors (in section 10).

# Part I

## CRT market developments since 2005

### 1. Selected developments in CRT products and participants

The Joint Forum's 2005 report<sup>1</sup> documented the rapid growth of new and innovative forms of credit risk transfer (CRT) associated with credit derivatives, which took place in the market for investment-grade corporate credit risk.<sup>2</sup> The key products described in that report were credit default swaps (CDS) on single corporate issuers ("single-name CDS"), collateralised debt obligations (CDOs) referencing portfolios of corporate issuers, and indexes of corporate credit risk. Since 2005, CRT activity became significant for two additional underlying asset classes, asset-backed securities (ABS) and leveraged loans. Appendix A describes in detail how CRT for corporate credit risk, ABS and leveraged loans has grown and evolved since 2005.

The 2005 report also discussed how banks, securities firms and insurance firms participated in the CRT market at that time. Appendix B describes how their participation has changed since 2005. One important development is the broadening of securitisation activity to new asset classes, which occurred as part of the growth of an "originate to distribute" business model at some of the largest banks and securities firms. Investors also played a role by seeking out higher-yielding investments in newly securitised asset classes, including ABS CDOs and CLOs. The appendix also identifies some participants in CRT markets whose importance has increased, including hedge funds, asset managers, structured investment vehicles (SIVs) and asset-backed commercial paper (ABCP) conduits.

This section discusses a few selected developments in CRT products and participants, focusing on those that are important background for the issues discussed in the body of the report and for the financial market turmoil that began in the summer of 2007:

- ABS CDOs and the ABX index
- CLOs and loan CDS
- The broadening of securitisation
- Hedge funds and asset managers
- SIVs and conduits

#### 1.1 ABS CDOs and the ABX index

For the issues discussed in the body of this report, and for the current market turmoil, the most important CRT products are CDOs that invested in ABS, so-called ABS CDOs. The recent crop of ABS CDOs is usually divided into two groups based on the quality of the CDO's collateral: "high grade" ABS CDOs invest in collateral rated AAA-A, while "mezzanine"

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<sup>1</sup> The Joint Forum, *Credit Risk Transfer*, March 2005. <http://www.bis.org/publ/joint13.htm>.

<sup>2</sup> Credit risk transfer in a broader sense, including guarantees, loan syndication, and securitisation, has a long history. This report, like the 2005 report, focuses on new developments in credit derivatives.



ABS CDOs invest in collateral predominantly rated BBB. Issuance of ABS CDOs roughly tripled over 2005–07 and ABS CDOs became increasingly concentrated in US subprime RMBS, with a minority of their portfolios invested in tranches of other CDOs. Figure 1.1 shows the typical collateral composition of high grade and mezzanine ABS CDOs.

Figure 1.1

**Typical collateral composition of ABS CDOs**

Percent

	High grade ABS CDO	Mezzanine ABS CDO
Subprime RMBS	50	77
Other RMBS	25	12
CDO	19	6
Other	6	5

Source: Citigroup

Before 2005, the portfolios of ABS CDOs were mainly made up of cash securities. However, after 2005, CDO managers and underwriters began using CDS referencing individual ABS, so-called synthetic exposures. “Synthetic CDOs” are those with entirely synthetic portfolios, while the portfolio of a “hybrid CDO” consists of a mix of cash positions and CDS. CDO managers and underwriters used synthetic exposures to meet the growing investor demand for ABS CDOs and to cater to investors’ preferences to have particular exposures in the portfolio that may not have been available in the cash market. CDO managers and underwriters were able to use CDS to fill out an ABS CDO’s portfolio when cash ABS, particularly mezzanine ABS CDO tranches, were difficult to obtain.

Figure 1.2 reports rough calculations of the amount of BBB-rated subprime RMBS issuance over 2004–07 and the exposures of mezzanine CDOs issued in 2005–07 to those vintages of BBB-rated subprime RMBS. The figure shows that mezzanine CDOs issued in 2005–07 used CDS to take on significantly greater exposure to the 2005 and 2006 vintages of subprime BBB-rated RMBS than were actually issued. This suggests that the demand for exposure to riskier tranches of subprime RMBS exceeded supply by a wide margin.

Figure 1.2

**BBB-rated subprime RMBS issuance and exposure of mezzanine ABS CDOs issued in 2005–07 to BBB-rated subprime RMBS**

USD billions

	Subprime RMBS vintage			
	2004	2005	2006	2007
BBB-rated subprime RMBS issuance	12.3	15.8	15.7	6.2
Exposure of mezzanine ABS CDOs issued in 2005-07	8.0	25.3	30.3	2.9
Exposure as a percent of issuance	65	160	193	48

Source: Federal Reserve calculations

The underlying assets of an ABS CDO are themselves RMBS tranches of diversified pools of mortgages. For this reason, an ABS CDO is a “two-layer” securitisation - a securitisation that invests in securitisations. In contrast, corporate CDOs and CLOs are “one-layer” securitisations with exposures directly to the debt of corporate issuers. Another type of “two-layer” securitisation that was discussed in the 2005 report is a “CDO-squared,” which is a CDO that invests in other CDO tranches. The subset of CDO-squared transactions that concentrated their portfolio in ABS CDO tranches are, not surprisingly, performing as poorly as, if not worse than, the ABS CDOs themselves in the current market turmoil.

Because ABS CDOs are two-layer securitisations, the risk characteristics of ABS CDOs are complicated, as Appendix C discusses in more detail. The diversification of RMBS pools means that losses on RMBS will be driven by systematic, economy-wide risk factors. ABS CDOs are therefore designed to perform well in most circumstances but can suffer especially steep losses during times of system-wide stress. The tranching of ABS CDO liabilities ensures that ABS CDO investors are exposed to an “all or nothing” risk profile that depends on the severity of the system-wide stress. Small differences in the level of system-wide stress can have large effects on the losses suffered by individual ABS CDO tranches. The “all or nothing” character of a tranche’s risk profile is more prominent for more senior tranches.

Also, as Appendix C notes, because ABS CDOs are so exposed to systematic risk factors, they naturally command higher spreads than similarly-rated corporate bonds. These higher spreads appear to have attracted a great deal of interest from investors, creating a growing demand for ABS CDOs from 2005 through the first half of 2007.

The performance of ABS CDOs during the current market turmoil is discussed in detail in section 3.2.

Dealers launched the ABX index in January 2006. The ABX references a portfolio of CDS on 20 large subprime RMBS transactions that were issued during a six-month period. The ABX index was an immediate success upon its launch, and a robust two-way market quickly emerged between investors (including CDO managers) seeking to take on subprime credit risk and investors with a negative view of the US housing market looking to short subprime credit risk. Still, the ABX never approached the level of liquidity found in the corporate CDS indexes (CDX and iTraxx).

During the market turmoil of 2007, the ABX index has been a visible marker of the growing distress of the subprime market. At the same time, the ABX has grown less liquid as the number of investors looking to take on subprime credit risk has shrunk. Although the regular six-monthly index roll was scheduled to take place in January 2008, it has been postponed because not enough subprime RMBS were issued in the second half of 2007 to fill a new index. As a result, the future of the ABX is in question.

Section 4.3 in the main report discusses some of the issues that arose in recent months as the ABX index became an important reference point for valuations of exposures to ABS CDOs.

## **1.2 CLOs and loan CDS**

Investors’ appetite for CDOs referencing leveraged loans, known as collateralised loan obligations (CLOs), has been the driving force behind the growth of CRT for leveraged loans. Issuance of CLOs has more than tripled over 2005–07, and CLOs have become the largest non-bank purchasers of leveraged loans in the primary market. A number of interviewed market participants expressed concern about the implications of the rapid growth of the CLO

market. Leveraged loans made in recent years did have riskier terms than earlier loans. Market participants expect this may delay the event of default for troubled borrowers, which may ultimately reduce recovery rates. Market participants said the market turmoil of 2007 has had a salutary effect on the CLO market, making it easier for CLO investors to push back against these trends.

Single-name CDS referencing leveraged loans, termed “loan CDS” or LCDS, has not grown as fast as some in the market had expected, though growth has picked up recently. Some CLOs are beginning to use LCDS in the underlying portfolio along with cash loans. Like the corporate CDS market, the LCDS market is becoming more liquid than the market for cash loans.

### **1.3 The broadening of securitisation**

The broadening of securitisation activity to new asset classes such as ABS and leveraged loans went hand in hand with a growing use of an “originate to distribute” business model at some of the largest banks and securities firms. These firms can profit from originating, structuring and underwriting CRT in a wider range of asset classes. They can earn fees while not having to hold the associated credit risk or fund positions over an extended time period. Investors also played a role in the broadening of securitisation by seeking out higher-yielding investments in newly securitised asset classes, including in ABS CDOs and CLOs. Strong investor demand for high-yielding securitisation exposures meant that banks and securities firms could originate (or purchase), structure, and distribute credit exposures that investors were willing to take on but that banks might have deemed too risky to hold on their own balance sheets for an extended period.

The broadening of securitisation has meant that origination standards in the newly securitised asset classes are now driven by the requirements of investors as much as by the credit views of the firms that originate the credits. As noted above, demand from investors for high-yielding ABS CDO tranches drove growth in the US subprime mortgage market to such an extent that dealer firms transferred more subprime risk to investors than was originated in 2005–06. Also noted above, leveraged loans made in recent years, when most loans were purchased by CLOs, had riskier terms than earlier loans. Some market participants have noted similar effects in other markets, such as commercial real estate, where CDOs now purchase a material fraction of originated assets.

### **1.4 Hedge funds and asset managers**

Hedge funds have become the most visible and active nonbank participants in CRT. A recent survey estimated that hedge funds represent approximately half of US trading volume in structured credit markets.<sup>3</sup> Because they are often early adopters of new CRT products, they provide liquidity and pricing efficiency to both new and established CRT instruments. Many of the largest credit hedge funds have expanded into numerous product and trading areas, and are themselves multi-strategy funds with a credit focus.

Market participants expect hedge funds to remain active in CRT markets, to continue to be important contributors to CRT innovations, and to increasingly compete in a variety of CRT products with traditional credit intermediaries, such as commercial and investment banks. Indeed, many of these traditional financial institutions describe hedge funds as both clients

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<sup>3</sup> *Hedge funds become the US fixed-income market*, Euromoney, September 2007, p. 10.

and competitors who seek to disintermediate traditional banking institutions in a variety of credit activities, including direct lending. Several market participants that the Working Group interviewed remarked that hedge funds (along with traditional distressed debt investment funds) have raised significant amounts of new capital in 2007 in order to position themselves to supply liquidity to those who might sell assets in stressed market conditions.

The line between the more sophisticated credit-focused hedge funds and asset managers is blurring. Several hedge funds leverage their in-house credit expertise to act as managers for CDOs that they help to structure. Some of these managers now manage more assets in CDOs and similar vehicles than in traditional hedge fund vehicles. Traditional fixed-income asset managers with a specialised expertise in credit markets may also act as the investment advisor for CDOs or credit hedge funds.

## **1.5 SIVs and conduits**

Some of the world's largest commercial banks sponsor asset-backed commercial paper (ABCP) conduits and structured investment vehicles (SIVs) that invested in CRT assets. Over the past several years, ABCP conduits and SIVs have been important purchasers of senior tranches in the CRT markets. They funded their investments in long-term CRT securities with short-term funding in the commercial paper and medium-term note markets. In this way they exposed themselves to the classic maturity mismatch that is typical of a bank: borrowing short-term and investing long-term. Like a bank, conduits and SIVs - and by extension the CRT market itself - were vulnerable to a run by debtholders. This proved to be a weakness in the market turmoil of 2007, as discussed in section 3.4 below.

## **1.6 The future of CRT**

The Working Group asked the market participants we interviewed for their predictions for the future of CRT. All thought the structured credit market would survive but would remain weak for a period of time. A common view was that ABS CDOs would either shrink dramatically or disappear. Two-layer securitisations like ABS CDOs, where a portfolio of securitised ABS is itself securitised in an ABS CDO, were viewed as too sensitive to underlying risk factors (such as house prices), too complex to risk-manage well, and too geared to rating agency rules. One market participant described these products as "model risk squared." Market participants thought that one-layer CRT products, such as CLOs or corporate CDOs, make economic sense and will survive. But they cautioned that some CLOs now invest in tranches of other CLOs in addition to loans, provoking an unpleasant association with the ABS CDOs that typically held 5–20 percent of their portfolio in tranches of other CDOs.

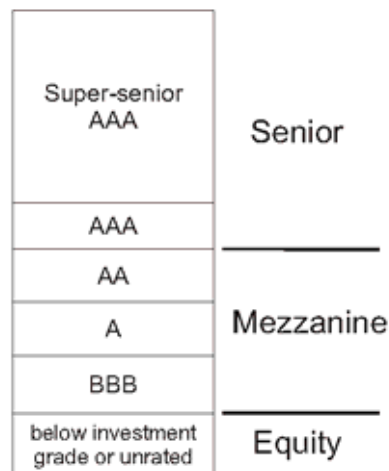
## **2. Who bears the risk in CRT?**

A structured CRT transaction, such as a CDO, invests in a portfolio of credit exposures and issues liabilities consisting of tranches of varying seniority. The tranches contain different risk-return tradeoffs that appeal to different types of investors. This ability of CRT to meet investors' diverse needs has been a major factor in the growth of the market.

Broadly speaking, the CRT capital structure can be divided into three slices (Figure 2.1): senior, mezzanine and equity. The senior part of the capital structure is made up of tranches rated AAA. This includes so-called super-senior tranches, defined as tranches that are senior to an AAA-rated tranche. The mezzanine part of the capital structure consists of tranches rated below AAA but still rated investment grade. The equity part of the capital structure is

either rated below investment grade or, as is often the case, not rated at all. When losses are realised on the underlying portfolio, equity investors absorb the first losses. After the equity is exhausted, mezzanine investors take subsequent losses, followed by senior investors.

Figure 2.1  
**The CRT Capital Structure**



## 2.1 Senior and super-senior investors

Banks (either directly or through conduits) typically focus on the senior and super-senior parts of the capital structure.

- Some SIVs and ABCP conduit managers, most of whom are banks, purchase AAA-rated senior and super-senior tranches.
- Many regional or smaller banks use senior (and also mezzanine) credit risk to diversify their credit portfolio.
- In the last couple of years, investment banks retained a great deal of senior and super-senior risk. Section 4.2 discusses the consequences some banks have suffered as a result.

Monoline financial guarantors are another important participant in the super-senior part of the capital structure. CRT now makes up 20–30 percent of the average monoline's portfolio, compared with around 10 percent at the time of the 2005 report. In recent months, some monolines have come under stress from their super-senior exposures to ABS CDOs. Issues related to monolines are discussed in section 3.5 below.

Senior CRT securities are also purchased by corporations and high net worth individuals who accept illiquidity, complexity and higher systematic risk in exchange for higher yields than other AAA-rated securities.

## 2.2 Mezzanine investors

Insurance companies and asset managers tend to be the largest investors in mezzanine CRT tranches. However, virtually every investor class, including Asian and European banks, global pension funds and hedge funds, participate to some extent in the mezzanine part of

the capital structure. Many large insurers worldwide have reduced their exposure to the stock market and sought greater credit exposure. Similarly, in Europe and Asia, insurers have often found CDS and CDO products a more efficient method of gaining credit exposure than regional corporate bond markets. CDOs themselves are also mezzanine investors, since as discussed in section 1 above, some CDOs buy mezzanine tranches of other CDOs.

Mezzanine investors tend to rely on credit ratings. Insurance companies and pension funds typically use credit ratings in their internal investment guidelines. Insurance regulation in many parts of the world uses a credit rating framework to determine regulatory capital charges. CDO managers are bound by investment guidelines that are based in large part on ratings. The role of rating agencies in CRT is discussed in more detail in section 3.3 below.

## **2.3 Equity investors**

Three different types of investors typically invest in the equity slice of the capital structure: asset managers, active traders and institutional investors. Some asset managers invest in the equity tranches of CDOs or CLOs that they manage. These asset managers treat CRT as a source of term financing for a credit portfolio chosen based on traditional fundamental credit analysis. According to one asset manager who invests in CDO equity, a portfolio of 10 percent CDO equity and 90 percent government bonds gives a better risk-return tradeoff than a portfolio fully invested in high-yield debt. Some market participants noted that CRT makes the pricing of credit risk more efficient by giving more weight to this group of well-informed investors.

Active traders, a category that includes hedge funds and dealers' proprietary trading desks, may buy equity tranches as one leg of a relative-value strategy. Some institutional investors, such as pension funds or insurance companies, buy equity tranches. They often view equity tranches as part of their small but growing allocations to "alternative investments," a catch-all category that also includes hedge funds and private equity.

## **2.4 The geographic distribution of CRT risk**

Geographically, the risk transferred in CRT is spread across the globe. The Working Group interviewed a number of market participants who are actively involved in structuring, marketing and managing CRT products. They estimated that, in aggregate, US managers sell CRT into the United States, Europe and Asia in roughly equal shares, while CRT from European managers splits 60–40 between Europe and Asia. As noted in section 1 and appendix C, most of the risk transferred in recent years was sourced from the ABS market, the leveraged loan market, or the investment-grade corporate market. All of these markets are dominated by US-based assets, with European assets making up a sizeable minority. On balance, this suggests that CRT contributes to a diversifying flow of credit risk out of the United States into the hands of a global investor base.

## **2.5 Who is bearing CRT losses?**

As expected losses on subprime mortgages mounted during 2007, the market value of the ABS CDOs that had taken on much of the subprime risk began to decline. The losses followed the pattern of risk-taking described above. The losses to senior and super-senior exposures generated the largest headlines, because that risk turned out to be concentrated at relatively few large banks, securities firms and monoline financial guarantors. Several of these firms took losses that wiped out an entire year's earnings, or in some cases, several years' earnings. The losses on mezzanine tranches appear to have been well-diversified

across many financial institutions, across sectors and around the globe. A large number of financial institutions worldwide have disclosed losses from mezzanine exposures of a material fraction of a quarter's earnings. Equity investors typically would not break out CDO losses from other trading results, but based on the absence of headlines, these exposures appear to have been either well-diversified or hedged.

Gross losses on ABS CDOs were larger than the actual losses on the subprime securities held by ABS CDOs because, as noted in section 1 above, ABS CDOs used derivatives to take on more BBB-rated subprime risk than was actually issued in 2005 and 2006. It is difficult to say for certain who was using credit derivatives to accommodate the demand for subprime risk from ABS CDO investors while positioning themselves to profit from weakness in the subprime market.

The market-wide dynamics and risk management failures behind these losses are discussed in more detail in the next part of this report.

## **Part II**

### **CRT in the current credit market turmoil**

#### **3. Weaknesses in CRT markets in 2007**

The market turmoil that began in the summer of 2007 exposed weaknesses in CRT. Weak origination standards contributed to rising delinquencies in the US subprime market. This fed into the CRT market through the ABS CDOs that had invested heavily in subprime RMBS. The ABS CDO market seized up when credit rating agencies announced widespread downgrades of subprime RMBS in July 2007. In August, the problems of the CRT market spilled over into short-term money markets as banks became concerned about the adequacy of their capital and the size of their balance sheets. These concerns led a credit event to become a liquidity event. In December, several monoline financial guarantors came under pressure due to CRT exposures. This section discusses these five issues in turn:

- Weak subprime origination standards.
- The performance of ABS CDOs.
- The role of credit rating agencies.
- The shift from a credit event to a liquidity event.
- The role of monoline financial guarantors.

Looking ahead, section 4 will discuss some of the risk management challenges that the largest banks and securities firms face from their CRT activities. Some of these firms failed to meet some of these challenges and suffered large losses as a result during 2007.

##### **3.1 Weak subprime origination standards**

Underwriting standards for US subprime mortgages originated in the past few years were extremely weak. Many of those mortgages had multiple layers of risk: less creditworthy borrowers, high cumulative loan-to-value ratios, and limited or no verification of the borrower's income. As house prices softened in late 2006 and 2007, the delinquency rate on adjustable-rate subprime mortgages soared. Lenders had had weak incentives to maintain underwriting standards given the strong investor demand for subprime risk. As noted in section 1 above, subprime risk was largely bought by ABS CDOs.

##### **3.2 The performance of ABS CDOs**

As noted in section 1 above, ABS CDOs are structured in a way that makes them highly exposed to the risk of a decline in US house prices. This is now being reflected in rating agency downgrades of these securities. During 2007, Moody's downgraded 31 percent of all the ABS CDO tranches it had rated. In some cases, these downgrades have reached to the top of the CDO capital structure: 14 percent of tranches initially rated Aaa were



downgraded.<sup>4</sup> Across all three major rating agencies, 12 ABS CDOs had AAA-rated liabilities downgraded to CCC or below during 2007; nearly all of these deals were originated in the first half of 2007.<sup>5</sup> Because mezzanine ABS CDOs invested in riskier collateral than high grade ABS CDOs, they are expected to suffer larger losses. One investment bank research report estimated that 94 percent of mezzanine ABS CDOs issued in 2006–07 will see their BBB tranche default, and 45 percent will see the junior AAA-rated tranche default.<sup>6</sup>

Another factor causing some stress in the ABS CDO market is the existence of default triggers in some ABS CDOs. These triggers are typically based on the ratings of the CDO's underlying portfolio. A typical trigger causes cash flows to be diverted from more junior tranches to more senior tranches. Other triggers result in the senior tranche investors being given the option to liquidate the CDO collateral, with the proceeds used to pay off the tranches in decreasing order of seniority. Around 50 ABS CDOs hit default triggers before the end of 2007, with about half entering liquidation.<sup>7</sup> For mezzanine and equity investors in ABS CDOs that liquidate their portfolio under current market prices and conditions, such a forced sale will presumably result in severe, and in some cases complete, losses.

### 3.3 The role of credit rating agencies

The growing complexity of CRT products and the growing participation of a diverse set of CRT investors have increased the influence of credit rating agencies since the 2005 report. Some investors appear to have entered the CRT market despite lacking the capacity to independently evaluate the risks of complex CRT products. These investors appear to have done little independent risk analysis of CRT products beyond relying on the rating. While the lack of independent risk analysis and reliance on rating agencies was also discussed in the 2005 report, this seems to have become more entrenched since then.<sup>8</sup>

The rating agencies have always sought to clarify their role by stating that their ratings only measure credit quality. They state that a credit rating is not intended to capture the risk of a decline in market value or liquidity of the rated instrument, nor should it be considered an investment recommendation. However, some investors do not seem to understand this point or simply ignore it. It seems likely that the way that investors use credit ratings for risk management of CRT products has lagged behind innovation in the markets.

Investors may not have been missing much when they came to treat the rating as a proxy for the general riskiness of a corporate bond. For corporate debt, there does seem to be a reasonably stable and logical relationship between the rating (a statement about the mean expected loss or default probability) and other types of risk (for example, the variance of losses or defaults or vulnerability to a cyclical downturn).

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<sup>4</sup> Moody's Investors Service, *Structured Finance CDO Ratings Surveillance Brief: December 2007*, 17 January 2008, Figure 15.

<sup>5</sup> Deutsche Bank Global Securitization Research, *Securitization Monthly: December 2007*, p. 3.

<sup>6</sup> UBS Global Fixed Income Research, *A Break in the Clouds?*, 3 October 2007.

<sup>7</sup> Moody's Investors Service, *Understanding the Consequences of ABS CDO Events of Default Triggered by Loss of Overcollateralization*, 7 January 2008.

<sup>8</sup> The Working Group did not focus on the broad role of credit rating agencies in structured finance markets, since IOSCO Technical Committee released a paper "*The role of credit rating agencies in structured finance markets*" in March and a working group of the Committee on the Global Financial System is currently studying that subject. Our observations in this section reflect comments from supervisors and interviewed market participants that relate specifically to the role of rating agencies in CRT markets.

But the pooling and tranching technology that is used to create CRT securities breaks this relationship and can create securities with a low expected loss but a high variance of loss or high vulnerability to the business cycle. For example, among 198 Aaa-rated ABS CDO tranches that Moody's downgraded in October and early November, the median downgrade was 7 notches (Aaa to Baa1) and 30 were downgraded 10 or more notches to below-investment grade. One was downgraded 16 notches from Aaa to Caa1. By contrast, looking across the entire Moody's database of corporate rating downgrades since 1970, no Aaa-rated corporate bond was downgraded lower than single-A (a maximum of 6 notches) in a single step. Thus, credit rating agencies grossly underestimated the credit risk of ABS CDO's. As a result, investors who relied only on such ratings have sustained significant losses.

Of course, as the 2005 CRT report recommended, investors should not rely solely on credit ratings in making risk judgements about ABS CDO's. Nevertheless, the complacency among market participants who were comfortable substituting a credit rating for their own due diligence appears to have been widespread. The widespread "outsourcing" of risk analysis may have been spurred, in part, by investment guidelines used by some market participants, which limited them, for example, to only purchase investment grade products or products rated AAA or AA. This complacency also extended to investors in the debt of SIVs, who seemed to rely on the high credit ratings of SIVs. These investors may not have recognised that the rating models for SIVs assumed that a rapid liquidation of the SIV's portfolio of illiquid CRT exposures could shield debtholders from losses. As discussed in section 4.2 below, this complacency extended even to the largest global dealer banks. Some of these banks reported that they chose to retain super-senior ABS CDO exposure in part because of its AAA rating.

For a more detailed description of the role of credit rating agencies leading up to the current credit market turmoil, see the report of the IOSCO Technical Committee entitled "*The role of credit rating agencies in structured finance markets*", May 2008 (available at [www.iosco.org](http://www.iosco.org)).

### **3.4 From a credit event to a liquidity event**

As the poor credit performance of subprime RMBS and ABS CDOs became apparent during the middle of 2007, investors began to pull back from ABCP conduits and SIVs that had invested in CRT. Even issuers of traditional commercial paper backed by corporate receivables had trouble issuing commercial paper for a time. Some commercial paper issuers drew on their bank liquidity facilities. In this way, a credit event turned into a liquidity event.

From the commercial paper market, the liquidity pressures quickly moved into the interbank market, where the largest banks faced additional pressures on their funding positions. The risk management failures that led to these additional pressures are discussed in more detail in section 4 below. As underwriters, these banks were left holding warehoused exposures in the leveraged loan, subprime RMBS and CDO markets that they had not expected to fund for more than a short period of time. Some banks provided funding to or bought assets from affiliated off-balance-sheet vehicles beyond their contractual commitments. Questions about the creditworthiness of some banks made banks reluctant to provide one another with funds in the term interbank markets. Overall, banks had paid too little attention to the liquidity implications of their CRT activities.

### **3.5 The role of monoline financial guarantors**

Monoline financial guarantors have played an important role in CRT markets for some time. The guarantors provide traditional financial guarantees on municipal bonds, MBS and ABS. They also sell credit protection against super-senior tranches of CDOs and CLOs. They participate in ABCP markets by providing credit enhancement on both a pool-specific and a transaction-wide basis for assets funded through ABCP issuance. Notably, the guarantors primarily guarantee positions whose stand-alone risk is investment grade. For CDOs, their positions are almost exclusively super-senior.

Financial guarantors have written roughly \$450 billion of super-senior protection on CDOs in the form of CDS contracts. About \$125 billion of these reference ABS CDOs. For the most part, the counterparties to these trades are large banks and securities firms or off-balance-sheet vehicles sponsored by these firms, including ABCP conduits. A number of the guarantors had tried to offset slower growth in other business segments by selling protection on super-senior tranches both of high grade and mezzanine ABS CDOs backed by subprime MBS collateral, as well as CDO-squared transactions.

The deterioration in the US housing and mortgage markets since 2006 has made it quite likely that the guarantors will suffer realised losses from many of these positions, including the super senior positions on ABS CDOs containing subprime collateral and CDO-squared transactions. Because the guarantors are highly leveraged, when measured by total insured positions relative to all claims paying resources, the potential for losses from CDOs has called into question the financial soundness of a number of the guarantors. As of this writing, most of the largest firms are currently looking to raise enough new capital to maintain their AAA ratings.

The implications of the weakened condition of the financial guarantors for the management of counterparty credit risk is discussed in section 4.5 below.

## **4. Risk management challenges for banks and securities firms**

Large banks and securities firms face a number of risk management challenges from their CRT activities. This section describes five of these that proved to be weaknesses during the market turmoil that began in 2007:

- Reputation risk, including the risk management of off-balance-sheet exposures;
- The warehousing of super-senior exposures;
- The complexity of some CRT positions, which makes them difficult to value and risk-manage;
- Correlation risk; and
- Counterparty credit risk on credit derivatives.

Some of these risk management challenges will be addressed in more detail in a paper that summarises interviews between global supervisors and 11 large financial firms during December 2007. The paper is expected to be published in February 2008.

## 4.1 Reputation risk

During the market turmoil, some market participants purchased assets from, or extended credit to, off-balance-sheet vehicles that they had organised and money market funds that they managed, even though they had no contractual obligation to do so. These actions suggest that, although it may have no legal requirement to assume exposures that have been transferred via CRT, a firm may make a business decision to do so. Such decisions may reflect reputation concerns. A business decision to assume a previously transferred risk may raise a question about the true extent of the original risk transfer. While it does not appear to be a widespread practice, at least one firm extends its internal risk measures to cover such “reputational risk” exposures, for example by including a separate line item for sponsored off-balance-sheet vehicles in a risk report on contingent liquidity risks.<sup>9</sup>

Bringing assets on-balance-sheet for reputation concerns should be distinguished from bringing assets back on-balance-sheet because of a contractual obligation. Securitisation contracts often contain a clause giving the transferee this right in the event a default occurs during a limited period of time after the transfer. Some firms, particularly originators, were legally compelled to buy back assets that they had previously transferred. Some firms had not factored risks from these binding legal commitments into their risk management or capital planning.

## 4.2 The warehousing of super-senior exposures

At some firms, the business model of CRT underwriting changed, perhaps unwittingly, from one focused on distribution to one focused on warehousing. In 2006–07, the strong demand from equity and mezzanine CRT investors for high-yielding investments left underwriters with large residual positions in super-senior tranches, especially for ABS CDOs. Underwriters had three alternatives:

1. Retain the super-senior positions, which used up balance-sheet capacity and had the potential for mark-to-market volatility;
2. Retain the super-senior positions but hedge by buying CDS protection on the ABX index or on the super-senior risk itself from investors, such as financial guarantors. This used up balance-sheet capacity but reduced mark-to-market volatility relative to the first alternative. It also created basis risk (for index hedges) and concentrated exposures to financial guarantors;
3. Sell the super-senior positions, typically to an off-balance-sheet vehicle such as a SIV or ABCP conduit.

Often underwriters used a combination of the above.

The risk management of all three alternatives was lacking at some banks. Retained super-senior positions that were risk-managed as trading exposures had shown little or no historical price volatility and did not register on typical trading risk measures, such as Value-at-Risk. This was especially true if the exposure was hedged (the second alternative). Selling a

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<sup>9</sup> The subject of reputation risk and its inclusion in firms’ risk management is discussed in more detail the Joint Forum report: *Cross-sectoral review of group-wide identification and management of risk concentrations* – March 2008.

senior position to a SIV or conduit, the third alternative, often left a firm still at risk of having to fund the position, as discussed in section 3.4 above.

### **4.3 .Complexity and valuation uncertainties**

The complexity of some CRT positions, such as ABS CDO tranches, makes them difficult to value. As discussed in Section 1 and especially in Appendix C, because ABS CDOs are two-layer securitisations, a small amount of uncertainty about expected subprime losses creates a large amount of uncertainty on valuations of ABS CDO tranches. Once the quality of ABS CDOs came into question in the middle of 2007, the market for CDO tranches became illiquid. There were few, if any, liquid market prices that firms could use to value the positions they held. Firms that had not developed the capability to model expected loss and default rates for CDO tranches were left with a problem: they were not able to value their positions. The growing requirement for fair-value measurement of financial instruments meant that these problems were widely noticed in financial markets.

The lack of market liquidity forced market participants to look for valuation information elsewhere. Market participants turned to indexes such as the ABX, whose fundamental risk characteristics broadly mimic that of the subprime RMBS underlying ABS CDOs (as discussed in section 1). However, market illiquidity also affected the ABX, which at the same time had become a hedging vehicle against a wide range of macro risks related to subprime and housing markets. Movements in the ABX seemed at times to be driven by hedging pressures rather than news about fundamentals. For example, during 2007, few market observers expected the losses on subprime mortgages, which were estimated to reach 10-15 percent, to materially affect AAA-rated tranches of subprime RMBS, which typically do not begin to suffer losses until the losses on the underlying portfolio of subprime mortgages reach 26-28 percent.<sup>10</sup> Still, the AAA-rated tranches of the ABX index were quite volatile in the second half of 2007 and some fell below 70 cents on the dollar in late November.

Market participants need to consider the impact of the combination of complexity, illiquidity and fair-value measurement in their risk management going forward. For example, a wide range of complex CRT products can be priced off a few liquid benchmarks. Hedging pressures can push these benchmarks away from fundamentals for a period of time. Transparency and fair-value measurement techniques often lag behind the development of new complex products. As CRT extends into more and more asset classes, this situation will become more widespread.

### **4.4 Correlation risk**

Correlation risk is a factor in many areas of the CRT market. Many CRT products, such as CDOs, are structured based on assumptions about the degree of diversification of an underlying portfolio. An estimate of the correlation of defaults among the exposures in the portfolio is a key input into a model used to design, value or risk-manage CDOs. The statistical concept of correlation refers to the average comovement of two assets or prices over time. But often what matters for the performance of more senior CDO tranches is the worst-case comovement, because that generates the largest losses on the underlying portfolio. This is especially true for the senior part of the CRT capital structure, which only suffers a loss when the losses on the underlying portfolio are very large. This difference between average and worst-case correlation can be difficult to incorporate into models and

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<sup>10</sup> Market participants have revised their forecasts for losses on subprime mortgages higher since then.

difficult for market participants to understand. As discussed in Appendix C, senior tranches of ABS CDOs are relatively more sensitive to correlated, economy-wide shocks.

To better identify and manage correlation risk, some firms have devoted time and energy to estimating “stressed correlations” to identify different parts of the portfolio that may experience higher-than-expected defaults in a stressed environment. Given the complexity of this analysis, some market participants feel there has been a heavy reliance on rating agencies’ analyses and assessment of correlation risk. However, for ABS CDOs, the correlation parameters in the rating agencies’ models were not derived from any empirical data, due to the short data history available on the default history of the underlying subprime RMBS.

#### **4.5 Counterparty credit risk**

Counterparty credit risk was an issue noted in the 2005 report, and it continues to be important. Dealer firms have seen tremendous growth in the gross value of their counterparty credit exposures. This growth has been driven by the growing role of hedge funds in CRT, as discussed in section 1 above. Dealers have reported few problems managing their counterparty exposures to hedge funds during the market turmoil of 2007. Still, firms are challenged to update their counterparty risk measurement systems to keep up with the complexity of CRT exposures. Supervisors conducted a multilateral review of dealers’ counterparty credit risk management in late 2006 and early 2007, and their report is expected to be completed soon. That report will detail several areas where supervisors will be pushing firms to improve their counterparty risk measurement and management.

The high volume of super-senior CRT risk that dealers hedged with monoline financial guarantors using CDS, as discussed in section 3.5 above, raises a deeper question about counterparty risk on super-senior exposures. Counterparty risk measurement has always acknowledged a concern with so-called “wrong way” exposures, namely, those exposures that are likely to be largest precisely when the counterparty’s creditworthiness is lowest. It is standard practice at large dealer firms to devote special effort to identifying and monitoring wrong-way exposures. Part of this special effort includes giving less credit, in terms of economic capital relief, for hedges with wrong-way counterparties. Monoline financial guarantors became wrong-way counterparties on super-senior CRT exposures when these exposures became a large share of their portfolio over 2005–07. Given the nature of super-senior exposures, which are designed only to take losses in the most severe stress events, it would seem prudent to ask whether there is any counterparty whose creditworthiness would be unaffected by the stress events that impose losses on super-senior tranches. The implication could be that a risk manager should classify any counterparty with material super-senior exposure as a wrong-way counterparty on CDS referencing super-senior risk.

## Part III

### CRT questions from the Financial Stability Forum and supervisors

#### 5. Where are there information gaps in CRT?

The question of whether there are information gaps in CRT has three aspects:

1. How much information is available on CRT products to investors and to the public;
2. Whether investors actually use the information available, rather than simply relying on a rating; and
3. The transparency of the gross and net flows of risk transfer that occur in CRT markets.

In the last few years the availability of information on CRT products and markets has increased significantly. One type of information is price data. Indexes and index tranches now provide daily price transparency for both investors and the public in many markets. For complex CRT products, such as CDO tranches, there are a growing number of third party valuation services, which have become an important information source for banks and investors, including hedge funds. On the other hand, the number of complex CRT transactions with little public price transparency has also increased significantly.

The availability of information on the structure of individual transactions can be quite different across CRT products. For simple products like CDS or indexes, information is often widely available to both investors and the public. For complex products like CDOs, documentation such as offering circulars, indentures and trustee reports are often only made available to dealers and certain qualified investors. Rating agency reports may be available to subscribers. CDO managers often provide only monthly information on the CDO's underlying portfolio. One reason for not releasing data in real time is that CDOs are not that liquid, so real-time data may not be of much use. Another reason is concern about revealing the manager's proprietary trading strategy. Information is also limited by the fact that many CRT exposures are offered as private placements of securities or in derivative form. Therefore, detailed information is often not available to the public, unlike registered securities (such as many mortgage-backed securities). In general, the more complex the product, the less access the public has to specific CRT deal documentation.

In some cases, even investors may not be allowed access to detailed information about the underlying portfolio, if it is forbidden by law or by the transaction's documentation. One reason for this is that borrowers may not want to disclose their data to unknown third parties. In these cases, investors must be satisfied with aggregated data on the structure of the underlying portfolio and not make an investment if aggregated information is not satisfactory.

Investors that the Working Group interviewed expressed a desire for more information on complex CRT transactions, both at origination and over the life of the transaction. At origination, investors would like to have access to all the information that a rating agency used to make its opinion. On an ongoing basis, investors would like CDO trustee reports to be more timely and to provide information in a standardised format, which would make the information easier for investors to analyse. Industry trade groups have proposed such formats but have not met with wide acceptance.

On the second point, even if investors have the ability to get information on a CRT transaction, it is still questionable whether all investors have the necessary skills, infrastructure and resources to understand and use all the information provided. It seems that not all investors are able and willing to analyse the sometimes several hundreds of pages, including hundreds of footnotes, in the documentation of complex CRT products in fine detail.

But the recent market turmoil has shown that detailed analysis of the underlying credits can be crucial for risk management. Without in-depth analysis, investors are in danger of not understanding the real exposure contained in complex instruments such as CDOs. Our interviews suggested that only the more sophisticated market participants, including some of those who specialised in fundamental credit analysis as the holder of first-loss equity positions, said they were able to drill down to underlying assets within their IT systems and analyse this information in detail.

A third issue is the opaqueness of credit risk transfer. As discussed in section 2 above, the broad outline of the risk transfer in CRT markets is reasonably clear. Aggregate data on CRT has improved in recent years. The BIS publishes semiannual data on credit derivatives, and the Securities Industry and Financial Markets Association (SIFMA) publishes quarterly data on global CDO issuance.

But for supervisors as well as for market participants, the identity of who bears the credit risk that has been transferred out of the banking system is not always clear. It can be difficult even to quantify the amount of risk that has been transferred. CRT data are often reported in terms of notional amounts, which are not a good guide to the amount of risk that is present in a complex structured CRT product. In recent months this has caused a number of “surprises” in terms of the actual degree of CRT risk exposure held at some firms.

## **6. What effect could CRT have on workouts?**

Workouts of troubled corporate borrowers have always been contentious. Multiple creditors will always have conflicting interests, disparate levels of expertise, and different information about the firm’s prospects. The growing use of CRT products by a larger number of market participants will lead to a more diverse participation in workouts, which may exacerbate the conflicts that naturally arise in a workout situation.

In past credit cycles, banks typically led the creditor committees in workouts. But under the “originate to distribute” model, banks frequently no longer have significant retained exposures, nor have they necessarily retained the personnel specialising in workouts who can steer creditor negotiations. A clear majority of all market participants now base their decision on whether to remain as a party to the restructuring process on the value that could be realised immediately by selling their exposure in the secondary market. A number of CRT investors, in particular, synthetic CDO managers, have stated that they have no workout expertise and no intention of participating in any restructurings. Further, members of the creditor committees may be unaware of the true net economic exposure of other members and the prices and terms on which their CRT trades were initiated.<sup>11</sup> The agendas of individual parties may vary from their apparent exposures and create some surprising dynamics within and between the creditor committees.

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<sup>11</sup> INSOL: *Credit Derivatives in Restructurings* (2006). <http://www.insol.org/derivatives.htm>.



It remains the case that a successful restructuring is dependent upon creditor committees reaching a consensus and the optimal principles to follow during an out-of-court restructuring are unchanged.<sup>12</sup> However, it is clear that parties who have invested in a distressed company at prices significantly below par have different return targets and investment horizons than the original investors. This situation may become more common, and market participants should expect tougher negotiations if that the parties to a workout are more heterogeneous than before. So far there is no evidence that a restructuring has failed on account of CRT trades held by members of the creditor committees, although it has on occasion made the process more complex.

## **7. Are there concerns about insider trading?**

Insider trading (also referred to as the misuse of material non-public information, or MNPI) is still a concern for regulators and participants in CRT markets. The 2005 report highlighted the perception of some market participants at that time that problems existed. The 2005 report recommended that banks and other market participants with access to MNPI should adopt policies and procedures to address these concerns.

The perception that there is a potential for insider trading to occur in credit derivatives markets has persisted since 2005, for several reasons. First, increased liquidity has made it easier to trade. Second, the broader availability of underlying names extends the space of exploitable trades on MNPI. Third, new market participants, such as private equity firms or hedge funds, may have access to private information, but often have less developed internal compliance structures. This area of concern was especially pronounced with respect to large leveraged buyouts (LBOs), where often many participants are involved and which can lead to a significantly increase in credit spreads. Some market participants noted that they have observed trading activity and price movements in advance of LBO deals that, to them, are a signal that some market participants have more information than others. The issues that arise here in the CRT market are largely similar to those that long existed in the equity market.

The biggest concerns arise in relation to the trading of single name CDS. This is especially true for LCDS trading, where there is more scope for private information. For example, the covenants included on a leveraged loan can determine whether or not it is deliverable into an LCDS trade. This can be private information and can affect the value of the LCDS.

Overall, market participants agreed that insider trading in credit derivative markets must be taken seriously and that high standards are desirable. Most market participants did not see insider trading as a major problem in the CRT markets and continue to stress the importance of industry recommendations provided by the Joint Market Practices Forum, a voluntary association of several trade organisations, which introduced recommendations in 2003 for the US market and a European supplement in 2005.

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<sup>12</sup> INSOL: *Global Principles for Multi-Creditor Workouts* (2000), <http://www.insol.org/statement.htm>.

## 8. Are there concerns about market infrastructure?

At the time of the 2005 report, there was widespread concern about market infrastructure for CDS trading.<sup>13</sup> There were two concerns:

1. dealers had excessive backlogs of unconfirmed CDS trades, and
2. secondary trading of CDS positions was being undertaken by assignments without the consent of the remaining party.

The prevalence of manual settlement mechanisms contributed to both problems.

During 2005, regulators worked closely with major credit derivative dealers to quantify the extent of operational backlogs. Targets were then agreed on the scale of reductions in credit derivative confirmations outstanding for longer than 30 days and the timeframe within which backlogs would be reduced. Dealers also committed to reduce the use of manual trade processing in favour of more automated systems. These targets were largely met, and quarterly public disclosures of industry average data are made on a range of metrics against which industry is benchmarking itself. More detailed disclosures are made to supervisors monthly.<sup>14</sup>

However, the situation deteriorated beginning in July 2007 as CDS trading volumes increased to 250 percent above average. This demonstrates that there are still significant challenges in achieving an acceptable “steady-state” for average CDS settlement timeframes. Regulators have held discussions with firms to set new targets and initiatives for reducing the credit derivative settlement timeframe, and progress is reported monthly.

The industry has increased the percentage of trades which are executed and settled electronically in order to avoid the more cumbersome settlement processes associated with manual systems. Deals executed and settled electronically constituted 45 percent of all credit derivative trading volumes in September 2005, but grew to 90 percent by September 2007. A number of hedge funds now “give up” all their CRT trades for settlement to their prime broker, which allows the hedge funds to benefit from the extensive systems investments made by their prime broker. Such funds have seen their average time for complete settlement fall from over 40 days to 1 day.

Issues associated with delays in the prompt notification of assignments have been significantly reduced since ISDA introduced its Novation Protocol in November 2005. This enhances the communication process between parties to novated trades and ensures the remaining party is informed on a timely basis that the transferor wishes to transfer an existing trade to a new counterparty.

Settlement risk is a market infrastructure concern that has grown since the 2005 report. The growth in CDS trading means that the value of outstanding CDS is now usually much greater than the underlying reference debt. This poses a risk when settlement takes place after a credit event. The typical settlement mechanism in a standard CDS contract is physical settlement. An investor who had bought credit protection must obtain eligible bonds

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<sup>13</sup> These issues are discussed in more detail in Committee on Payment and Settlement Systems, *New developments in clearing and settlement arrangements for OTC derivatives*, March 2007. <http://www.bis.org/publ/cpss77.pdf>.

<sup>14</sup> The public disclosures are at <http://www.markit.com/information/products/metrics.html>.

referenced by the CDS, if the investor did not already own eligible bonds, and then deliver the bonds to the protection seller in exchange for par. Because CDS contracts must be settled in a short period of time following a credit event, physical settlement could lead to an artificial scarcity that bids up the price of the referenced bonds. Also, bottlenecks in the settlement process could result as many transfers of bonds must occur in a short period of time.

A key development has been the emergence of credit event auctions. These auctions give investors the option of cash-settling their CDS and LCDS trades, after a credit event has been triggered, at a price that is set in a market-wide auction. This removes the need for all investors who have bought credit protection to obtain the actual eligible bonds in a short period of time.

However, each auction is an ad hoc process that must be quickly agreed to following a default. Settlement risk will still be high until the auction settlement mechanism is incorporated into standard CDS documentation and is tested in actual defaults, including some in less benign market environments. The cash settlement auction has not been quickly embraced by non-dealer CDS counterparties, perhaps because they worry that the process favours dealers over non-dealers.

Another element of settlement risk concerns the lack of experience with credit events for CDS referencing new CRT asset classes. The documentation for CDS trades referencing corporate obligors has been tested many times and settlements have, in recent years, gone smoothly. Until new CRT asset classes go through similar tests, there will be uncertainty about how smoothly settlements will run. In particular, CDS on ABS and CDS referencing monoline financial guarantors have not been tested as thoroughly as CDS on corporate obligors.

## Part IV

### Supervisors' concerns and recommendations

#### 9. Issues raised in Survey of Supervisors for Update of 2005 Paper

As was done for the 2005 report, the Working Group surveyed the banking, securities and insurance supervisors who participate in the Joint Forum regarding this update. This section summarises issues raised in the responses as of November 2007.

##### Complexity

Supervisors expressed concern that the complexity of some CRT products and activities challenges the ability of boards of directors and senior management to understand and evaluate the risks of these products and activities and to set appropriate risk limits. Supervisors also observed that some firms' internal risk reporting practices did not provide sufficient information regarding the volume and nature of their CRT activities, hindering their ability to monitor the firms' risk profiles against approved risk tolerances.

In addition, many market participants appeared not fully to appreciate how one type of risk (eg liquidity) can quickly evolve into another type (eg market and credit risk) in CRT.<sup>15</sup> The lack of liquidity and corresponding drop in market value of highly rated CDO tranches, which was not anticipated by most market participants, provides an important example.

##### Rating agencies

In light of the concerns about complexity noted above, supervisors were concerned that some firms relied too much on credit rating agency ratings, with little or no in-house due diligence on the CRT products employed. Especially noteworthy is the fact that some firms invested in CRT products despite knowing little about the assets underlying these investments. This problem was most common in two-layer securitisations, in ABCP conduits, and in "enhanced" money market funds.<sup>16</sup>

As a result, supervisors believe that market participants should better understand the details of the CRT products in which they invest. Market participants should understand how the ratings agencies assign ratings to specific instruments and what circumstances would lead them to downgrade ratings (though there was not agreement whether the burden should fall more on the rating agencies to provide more information or the users of the ratings to more effectively use the information already provided).

From a broader perspective, there was concern with the extensive role that rating agencies play throughout the CRT market. The rating agency ratings, analyses and actions are a

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<sup>15</sup> The subjects of interrelatedness of risk factors and second-order effects are treated in more detail in the Joint Forum report: *Cross-sectoral review of group-wide identification and management of risk concentrations* – March 2008.

<sup>16</sup> Appendix B defines and discusses 'enhanced' money market funds.

critical factor in the creation of structured products, as inputs in market participants' internal models, in the ongoing valuation of products, and in the formation of expectations for downgrades and consequent market liquidity for given CRT products. Thus there is concern that this extensive reliance on rating agency ratings represents a "concentration risk" within the CRT markets.

For a more detailed description of the concerns of securities regulators, see the report of the IOSCO Technical Committee entitled "*The role of credit rating agencies in structured finance markets*", May 2008 (available at [www.iosco.org](http://www.iosco.org)).

### **Valuation and risk modelling**

Supervisors also raised concerns about valuation and risk modelling. Because complex and model-driven transactions and hedging strategies give rise to model risk, a firm may not be as well-hedged as intended. Supervisors expressed concern about firms' ability to capture credit risk in their Value-at-Risk models (and in the related regulatory capital charges).<sup>17</sup> As a result, supervisors noted the need for stress tests, as well as scenario and parameter sensitivity analyses, to challenge routine risk analytics on complex CRT products. Due to the growth of new and complex CRT instruments, however, some supervisors expressed concern that there is little relevant historical data available for effective risk modelling.

There are also questions about the reliability of fair values in markets with little or no liquidity and firms' ability to calculate such values using internal models. A number of supervisors noted that this concern is particularly pressing given the adoption of new accounting standards allowing for fair valuation.

Numerous supervisors shared the concerns about correlation risk discussed in section 4.4 above. In addition, insurance supervisors noted that the large scale mutualisation process that is the basis of reinsurance can fail if credit risk globally is too correlated.

### **Liquidity**

The importance of market liquidity in CRT is highlighted by recent credit market events, with one supervisor noting that "derivatives have created the tools to manage every risk except liquidity."

Supervisors are concerned that the "originate to distribute" business model makes a firm more dependent on market liquidity. A drying-up of market liquidity can impact a firm's ability to move credit assets off the balance sheet, disrupting the "pipeline" business model of a firm that originates or purchases credit assets with the expectation that they will be quickly sold. In this way, the "originate to distribute" model can generate unintended and large credit exposures to names, industries, asset classes and geographic regions in times of stress. It can also cause a firm to retain its market risk exposure for a much longer period of time than originally intended. Finally, it can lead to unanticipated funding difficulties for firms.

These market liquidity risks also apply to CRT products purchased as investments for asset managers and insurers. These risks can become acute when firms fund such investments

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<sup>17</sup> The Basel Committee is currently consulting on proposed guidelines for implementing a new requirement for banks that model specific risk to measure and hold capital against default risk that is incremental to any default risk that is captured in the bank's Value-at-Risk (VaR) model.

with short-term liabilities and rely on the market liquidity of the CRT assets to avoid asset/liability mismatch problems.

Some supervisors further worry that a decline in market liquidity can be exacerbated by leveraged transactions and participants, creating the potential for a vicious cycle of unplanned asset sales and margin calls driving prices lower, necessitating further sales and weakening of prices.

### **Operational, legal, and reputation risk**

Supervisors consider that operational risk and questions about the legal certainty of credit risk transfer still exist but are generally thought to be under control. As discussed in section 8 above, market infrastructure has had difficulty keeping pace with CDS transaction volumes, but the situation has improved markedly since 2005. Some supervisors noted the potential problems associated with the physical settlement of CDS (as opposed to cash settlement), also noted in section 8.

Supervisors consider reputation risk, on the other hand, to be a much more pressing issue. A key concern is the support that some firms provided to entities, business lines or CRT products where the firm had no legal obligation to do so, but did anyway in order to preserve its reputation and future business. Supervisors expressed concern that these reputation risks lead firms to take back exposures that have been legally transferred, harming firms' financial conditions, and moreover that firms had insufficient risk management plans in place prior to the recent credit market turmoil to address this risk. In some cases, these actions also created significant negative press and spurred investor lawsuits.

As discussed in section 5 above, a lack of transparency for some CRT products and markets raises the question of whether different parties in the CRT market understood the products and risks sufficiently well. There are limits to transparency between firms (eg about access to the terms of some products or the assets underlying them); in information available to the public; and in information available to supervisors.

### **Broader concerns**

Supervisors recognise that, in principle, systemic risk is reduced by CRT as risks are transferred to firms or sectors that prefer to hold them. Some supervisors are concerned about the possibility that regulatory arbitrage might prompt the transfer of risk to intermediaries or markets that are subject to less stringent regulation and oversight, including hedge funds. Some supervisors also expressed concern that it is difficult to develop a clear picture of which institutions are the ultimate holders of some of the credit risk transferred in CRT transactions.

As a result of these concerns, some supervisors believe that the effects of a severe market disruption, or the failure of a major participant in the CDS or CDO markets, could now be greater, and that there is a greater likelihood of transmission to the credit market in general, or even more broadly to the real economy.

Some supervisors were concerned that the relationship between innovation in the structured credit markets and the prosperous economic environment had led to excessive leverage. Securitisation freed up capital that otherwise would have been allocated to originated loans, and thus provided a source of funding for banks and securities firms. Securitisation products often incorporated additional leverage that increases the relative demand for the securitisation products. By adding this demand and by adding to market liquidity, these

structures contributed to a tightening of credit spreads. While the low spread environment created favourable credit conditions for corporates and households, underpinning the growth of the economy, there was concern that this cycle would encourage excessive leverage.

Some supervisors were concerned that two-layer securitisations, such as ABS CDOs, added a layer of complexity to traditional RMBS and thereby further separated the final traded product and end-investors from the underlying fundamental credit risk. As a result, some new CRT products may provide little or no “credit message.” These supervisors were concerned that market discipline may not play an effective role to restrain credit extension when such highly structured products are used to disperse the underlying credit risk.

Other supervisors felt that, while structuring credit may reduce credit signals through the normal credit cycle, this may primarily affect senior and super-senior tranches. At the same time, equity tranche investors are hypersensitive to fluctuations in the normal credit cycle. Overall, the credit message is not lost, but amplified for some, muted for others, with the net effect uncertain. In addition, innovations such as the tremendous growth of CRT indexes may add to market signals.

All supervisors agreed that these broad concerns dealt with complicated issues that were not the focus of the Working Group’s interviews with market participants and are worthy of further study.

Finally, it should be noted that supervisors in a number of countries believe that CRT activities do not raise significant regulatory concern in their jurisdictions because only a limited number of significant firms participate in CRT, the degree of concentration in the market segment seems to be declining, or only a few entities are active in the derivatives markets, mainly as protection buyers.

## 10. Recommendations

The recommendations contained in the Joint Forum’s 2005 report on Credit Risk Transfer are comprehensive and remain largely applicable today. Although the 2005 recommendations were written from the perspective of credit risk transfer of corporate credits, the recommendations are relevant to credit risk transfer products for other asset classes. Given the limited time for this update, the Working Group did not attempt a comprehensive survey of progress made toward the 2005 recommendations.

The Working Group has developed recommendations that supplement, and in some cases go beyond, the 2005 recommendations. Where a recommendation is closely linked to one of the 2005 recommendations, a cross-reference is noted in a footnote. The complete text of the 2005 recommendations is given in Appendix E.

Going forward, market participants and supervisors should use the recommendations in this report together with the recommendations from the 2005 report as a single package of recommendations to improve risk management, disclosure and supervisory approaches for credit risk transfer.

1. **Senior Management Review.** Senior management at firms participating in the CRT markets should review CRT activity regularly to ensure that the risks taken are consistent with the firm’s risk tolerance. Senior management should formally approve any fundamental changes to the business model associated with CRT activities as soon as they become material which should prompt a senior level

discussion with the firm's regulator. Senior management should also ensure an appropriate depth of understanding throughout the firm exists.<sup>18</sup>

2. **Credit Analysis.** Market participants should conduct a-credit analysis appropriate to the CRT instruments, making sure they understand the structure and other important variables that determine value. In the case of securitised (and resecuritised) assets, such credit analysis should extend to the originated assets underlying the transaction. Market participants should evaluate carefully the reasons for differences in yields for securities irrespective of credit rating and assess whether historical data for the underlying exposures are relevant in the current environment.<sup>19</sup>
3. **Stress Testing.** Market participants that are active in the CRT market should incorporate a rigorous stress testing or scenario analysis program into their risk management of CRT activities. The recent market turmoil suggests that stress testing needs to be broader and more severe than it has been to date. Stress testing is particularly important when evaluating assets that do not have a robust data history and for complex CRT products. Stress tests should give due attention to liquidity risk.
4. **Risk Measurement.** Market participants should ensure that they assess and manage risks in CRT comprehensively across the firm, aggregating exposures consistently and taking advantage of the views of all business units with an expertise in the asset class.<sup>20</sup> Market participants should also ensure that they are assessing the interrelationships among risks in CRT in their risk management and stress testing. (The Joint Forum paper "Cross-sectoral review of group-wide identification and management of risk concentrations" April 2008 provides additional analysis).
5. **Concentration Risk.** Market participants should identify and avoid undue concentrations of risk through using CRT products and evaluate carefully their risk tolerance for, and ability to assume, liquidity risks associated with CRT activities.<sup>21</sup>
6. **Complex Products.** Market participants should have the capacity to risk-manage and value their complex CRT positions. Complex CRT products may not easily fit into normal risk management processes and may require special attention. An independent valuation function is especially important for such products.
7. **Valuation and Accounting.** Market participants should have in place procedures to ensure that the values used to measure and manage the risk in CRT positions are consistently reflected in the accounting process. Such a requirement is especially important for those positions belonging to portfolios to be reported at fair value. Those ultimately responsible for determining valuations for financial statements must be independent from the risk taking function.
8. **Model Validation.** Market participants should not establish material positions in complex CRT instruments without first establishing a process for validation and the

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<sup>18</sup> This recommendation supplements 2005 recommendation 1.

<sup>19</sup> This recommendation supplements 2005 recommendation 2.

<sup>20</sup> This recommendation supplements 2005 recommendation 2.

<sup>21</sup> This recommendation supplements 2005 recommendation 12.



periodic review of the models or fundamental analysis utilised to risk-manage such exposures. Market participants should consider how, under stressed conditions with little or no market liquidity, an informed judgement on the value of their positions will be made.<sup>22</sup>

9. **Structured Finance and Corporate Ratings.** Rating agencies should do more to differentiate ratings on structured finance securities from ratings on corporate bonds and also to indicate the contribution of external credit enhancement assigned to CRT products.<sup>23</sup> Market participants should also differentiate between credit ratings on structured products and credit ratings on corporate bonds in how they use each rating. Market participants should work with existing credit rating agencies and others to produce supplementary measures that provide the information needed to make informed decisions about the risk of structured finance securities.<sup>24</sup>

Investors should never rely exclusively on external ratings when evaluating CRT instruments. Investors should supplement external credit ratings with their own robust analysis, including specific assessments of whether assumptions made by the rating agencies in determining the rating are reasonable.<sup>25</sup> Investors should carefully consider how they use credit ratings in their investment guidelines and investment mandates, in order to avoid creating unintended incentives for traders to take excessive risk. Investors should carefully consider how they use credit ratings for valuation, risk measurement and reporting, including in reports to senior management and boards of directors.

Supervisory authorities should review their use of credit ratings to determine if they need to clarify the distinction between corporate and structured finance ratings.

10. **Counterparty Risk.** Market participants should carefully consider the correlation of their counterparty risk with the underlying exposure hedged. Decisions to hedge exposures with “wrong way” counterparties should be reviewed and approved by appropriate levels of senior management.<sup>26</sup> In particular, market participants should review how they measure the benefits from insurance provided by monoline insurers to senior and super-senior risk exposures.
11. **Reputation and Off-balance-sheet Risk.** Market participants should regularly review their CRT activities to assess the conditions under which they might feel compelled to assume exposures that they had legally transferred, either under the relevant accounting standards or for reputation or other reasons. Each firm should identify legal and reputational risk exposures in its internal liquidity risk management reporting and have a contingency plan for either dealing with the expected exposures that may come back on balance sheet or the business implications of damage to reputation. The plan should address the impact on the firm’s liquidity, credit rating and capital adequacy. As part of the new business approval process, each firm should consider whether a new business activity presents heightened reputation risk, and take steps to minimise this risk.

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<sup>22</sup> This recommendation supplements 2005 recommendation 3.

<sup>23</sup> Supervisors’ concerns about rating agencies were noted in section 9 above.

<sup>24</sup> This recommendation supplements 2005 recommendation 4.

<sup>25</sup> This recommendation supplements 2005 recommendation 4.

<sup>26</sup> This recommendation supplements 2005 recommendation 6.

12. **Use of Material Non-Public Information.** Market participants should implement strict compliance rules to address the potential conflicts of interest and to prevent inappropriate use of MNPI.<sup>27</sup>
13. **Settlement Risk.** Market participants should maintain momentum toward establishing a Cash Settlement Protocol in order to eliminate the delivery problems that can occur when CDS contracts exceed available deliverable instruments.<sup>28</sup> To limit settlement risk on credit default swaps, market participants should continue work to incorporate a cash settlement auction mechanism into standard CDS documentation. The terms of the auction mechanism should be agreed by both dealers and end-users.
14. **Trade Automation.** Market participants should continue to move towards automating trade novations and setting rigorous performance standards earlier in the trade processing cycle.<sup>29</sup>
15. **Workouts.** Market participants should be aware of the potential for credit derivatives and positions held through other CRT products to affect the dynamics of corporate workouts, especially for out-of-court restructurings before an actual event of default.
16. **Funding Liquidity Risk.** Market participants should actively manage the liquidity risk inherent in funding CRT assets with short-term liabilities.
17. **Disclosure.** Market participants should increase efforts to provide meaningful disclosures with respect to their CRT activities. The Joint Forum reiterates the entire set of disclosure recommendations from the 2005 report.<sup>30</sup>
18. **Supervisory requirements.** Supervisors should evaluate the capital requirements for structured credit exposures, especially those based upon external credit ratings. Additionally, supervisors should ensure that institutions have well-developed frameworks for identifying concentration risks, and assess the need for capital requirements for such risks.<sup>31</sup>
19. **Supervisory Oversight.** Supervisory authorities need to ensure that they have the requisite resources and expertise to oversee CRT activities at the firms they supervise, and should ensure that these firms in turn have the capacity to understand and manage all of the risks in their CRT positions.

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<sup>27</sup> This recommendation supplements 2005 recommendation 9.

<sup>28</sup> This recommendation supplements 2005 recommendation 10.

<sup>29</sup> This recommendation supplements 2005 recommendation 10.

<sup>30</sup> This recommendation supplements 2005 recommendation 13.

<sup>31</sup> This recommendation supplements 2005 recommendation 16.

# Appendix A

## Developments in CRT products

Surveys of the credit risk transfer market usually begin by referring to the astounding growth of the notional amount of credit derivatives outstanding. This growth is indeed impressive—the notional amount of credit derivatives outstanding has doubled each year since 2001 and now exceeds \$50 trillion.<sup>32</sup> While these numbers are impressive, the truly remarkable aspect of CRT is its mutability. Every year or two, CRT on a different type of underlying asset has extended the market's growth. Still, CRT activity on new types of underlying assets tends to use the same familiar set of CRT products.

The Joint Forum's 2005 report documented the early and rapid growth of CRT, which took place in the market for investment-grade corporate credit risk.<sup>33</sup> The key products described in that report were credit default swaps (CDS) on single corporate issuers ("single-name CDS"), collateralised debt obligations (CDOs) referencing portfolios of corporate issuers, and indexes of corporate credit risk. Section A.1 documents how CRT for corporate credit risk has continued to grow and evolve.

Since 2005, CRT activity became significant for two additional underlying asset classes, leveraged loans and asset-backed securities (ABS). For both, the important CRT products are again single-name CDS, CDOs and indexes. The new CRT activity is described in Sections A.2 and A.3, respectively. CRT products containing mark-to-market triggers, so-called market value products, are another growth area that is described in Section A.4.

### A.1 CRT for corporate credit risk

#### Single-name CDS

The 2005 report focused on CRT for corporate credit risk, and the trends cited in that report have endured. The single-name CDS market has continued to grow larger and more liquid. The 2005 report noted that the CDS market was concentrated in investment-grade names at the 5-year maturity point. But both concentrations have weakened since 2005. High-yield names and maturities away from the 5-year point are now traded actively, particularly the 10-year point. More emerging market names, both sovereign and corporate, are also now traded. For actively-traded names, the CDS market is now more liquid than the corporate bond market, with a lower bid-offer spread and a more rapid reaction to news about corporate fundamentals. This has contributed to market efficiency and price discovery.

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<sup>32</sup> Bank for International Settlements, *Triennial Central Bank Survey: Foreign exchange and derivatives market activity in 2007*, December 2007, p. 2. <http://www.bis.org/publ/rpfx07t.pdf>.

<sup>33</sup> <http://www.bis.org/publ/joint13.pdf>.

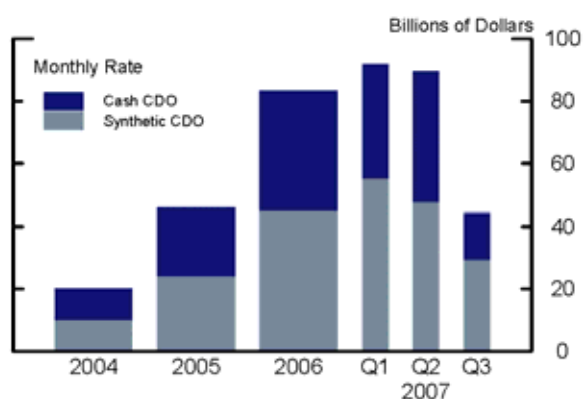
## Corporate CDOs

As discussed in detail in the 2005 report, a collateralised debt obligation (CDO) is a structured credit transaction where the credit risk of a portfolio of underlying exposures is segmented into tranches of varying seniority and risk exposure. The 2005 report noted the rise of synthetic CDOs, which are CDOs whose underlying portfolio consists of single-name CDS. In contrast, the underlying portfolio of a traditional cash CDO consists of cash bonds. Figure A.1a shows the rapid growth of CDO issuance in both cash and synthetic form. Investment-grade corporate credit risk is nearly always transferred in synthetic form. The fact that cash CDOs have kept pace with synthetic CDOs is a new development since the 2005 report. As shown in Figure A.1b, the growth of cash CDOs reflects CRT in the leveraged loan and ABS markets, which will be discussed in sections A.2 and A.3 below.

Three trends in corporate CDOs have emerged or accelerated since the 2005 report. First, dealers now primarily use single-tranche synthetic CDOs to accommodate investors' demand for tranching investment-grade corporate credit risk. In a single-tranche CDO, the dealer sells only one tranche of the capital structure, typically the mezzanine, and hedges its risk exposure with a variety of other credit derivative products. Second, CDOs increasingly use actively managed portfolios, giving an asset manager the ability to rebalance the CDO's portfolio away from poorly performing credits. Third, and related to the increase in active management, it has become common for a CDO to allow the manager to include some short positions in the CDO's portfolio. This was a response to low credit spreads in 2006 and the growing market belief that the credit cycle would soon turn and spreads would widen.

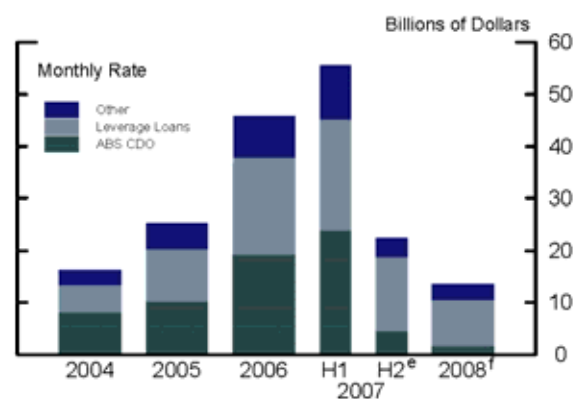
Figure A.1  
CDO issuance

USD billions at a monthly rate



(a) CDO issuance

(Source: SIFMA, Creditflux)



(b) Underlying collateral for cash CDO issuance

(Source: JP Morgan Securities)

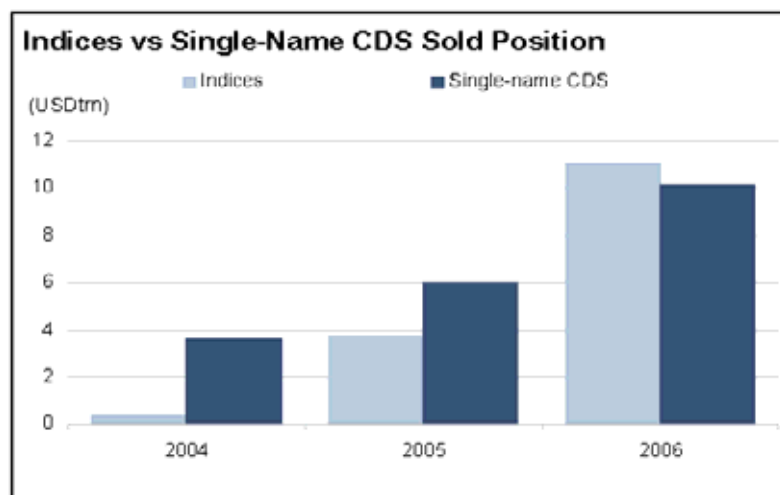
## CDS indexes and index tranches

Since 2005, the most exceptional growth in corporate CRT has been in credit default swap indexes and index tranches. Indexes marketed under the CDX and iTraxx brands now cover all major corporate credit markets worldwide, including North America, Europe, Japan, Asia ex-Japan, and Australia, with separate indexes in many cases for investment-grade, high-yield, and crossover (credits nearest the boundary between investment-grade and high-yield). Trading volume in indexes is now three times greater than single-name CDS volume,

and index trades outstanding have now outstripped single-name CDS, as shown in Figure A.2.<sup>34</sup> The most popular indexes are for investment-grade corporate credits, with around 90 percent of the market. Other indexes include the LCDX for leveraged loans and the ABX for subprime RMBS. As the most liquid CDS products, indexes attract a great deal of short-term trading and hedging. Institutional investors seem to prefer the customised (“bespoke”) portfolios that are available in the synthetic CDO market and tend not to use indexes for long-term investment in corporate credit risk.

Figure A.2  
**Notional amount outstanding of CDS indexes and single-name CDS**

USD trillions



Source: Fitch Ratings

CDS indexes have been designed by the dealer community to gain wide acceptance with market participants. The various CDS indexes referencing different underlying asset classes share several characteristics that have made them successful. These include

1. **Transparent rules:** Each index is rebalanced twice a year according to a transparent set of rules.
2. **Committed liquidity:** The dealers that created the indexes also commit to serve as market-makers. Price quotes for the indexes are widely available.
3. **Operational efficiency:** The indexes trade and settle electronically.

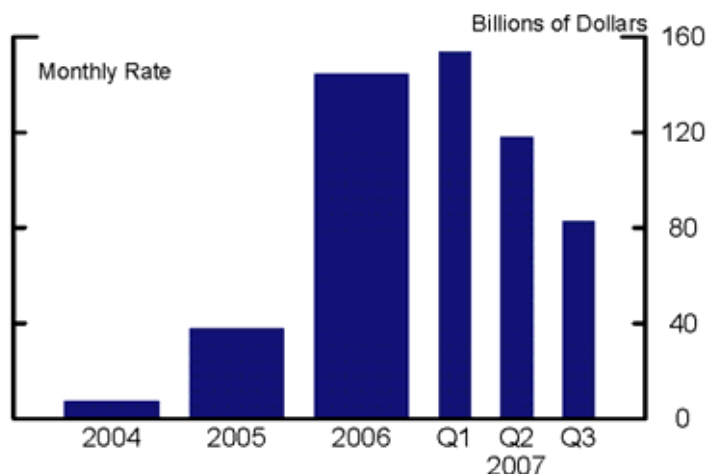
An index tranche is a single-tranche CDO with a CDS index as the reference portfolio. Figure A.3 shows the growth of the volume of index tranche trades. A standardised set of tranches trade in liquid markets. Dealers use index tranches, along with single-name CDS and CDS indexes, to hedge the exposures that arise from single-tranche CDOs they have sold to investors. This so-called “correlation trading” presents a formidable risk management challenge that remains, as noted in the 2005 Report, more art than science. The correlation market experienced a disruption in May 2005, when the market prices of some credit index

<sup>34</sup> Fitch Ratings, *CDx Survey - Market Volumes Continue Growing while New Concerns Emerge*, 16 July 2007.

tranches moved in unexpected ways that led to trading losses for a number of market participants.

Figure A.3  
**Issuance of index tranches**

USD billions at a monthly rate



Source: Creditflux

## A.2 CRT for leveraged loans

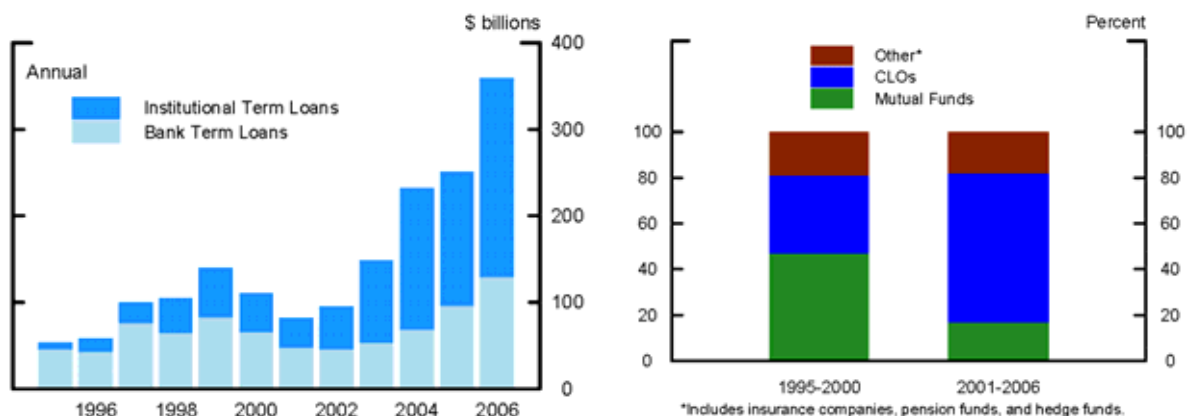
### Collateralised loan obligations (CLOs)

CRT for leveraged loans, a term used for loans to riskier corporate borrowers, has grown steadily since 2005. Investors' appetite for CDOs referencing leveraged loans, known as collateralised loan obligations (CLOs), has been the driving force behind the growth of CRT for leveraged loans. Before 2001, banks were the main investors in leveraged loans, as Figure A.4a shows.<sup>35</sup> Since 2001, the share of non-bank investors has grown steadily. As Figure A.4b shows, CLOs have become the largest non-bank purchasers of leveraged loans. Demand for loans from CLOs has largely been met by loans sourced from corporate mergers and acquisitions, particularly leveraged buyouts (LBOs), rather than from loans funding new capital investments.<sup>36</sup>

<sup>35</sup> This refers to funded term loans, not commitments.

<sup>36</sup> A working group of the Committee on the Global Financial System is currently examining issues related to private equity and leveraged finance. Their report, which is expected to be published in the first half of 2008, gives more background on the leveraged loan market and CLOs.

Figure A.4  
The leveraged loan market



(a) Investors in US term loans

Source: Loan Pricing Corporation

(b) Non-bank investors in institutional term loans

Source: Standard & Poor's

A number of interviewed market participants expressed concern about the implications of the rapid growth of the CLO market. Leveraged loans made in recent years had riskier terms than earlier loans, including weaker covenants and the ability to pay interest “in kind” when a company enters financial distress. Market participants expect these riskier terms to delay the event of default for troubled borrowers, which may ultimately reduce recovery rates. Investors found that they had little bargaining power against borrowers and underwriters, and often had to choose between accepting unfavourable terms or not investing in the leveraged loan market. Market participants said the market turmoil of 2007 has had a salutary effect on the CLO market, making it easier for CLO investors to push back against these trends.

## Loan CDS

Single-name CDS referencing leveraged loans, termed “loan CDS” or LCDS, has not grown as fast as some in the market had expected. LCDS made up only about 1.5 percent of total single-name CDS outstanding at year-end 2006. Growth has picked up recently, however, for several reasons. The International Swaps and Derivatives Association (ISDA) and the Loan Syndications and Trading Association (LSTA) issued standardised documentation for LCDS in June 2006, and documentation focused on the European market was issued in July 2007. Wider credit spreads in 2007 have encouraged more hedging, leading to more two-way flows in the market. Moreover, some CLOs are beginning to use LCDS in the underlying portfolio along with cash loans. Hedge funds are increasingly using LCDS for many of the same relative value trading strategies that have boosted the liquidity of the corporate CDS market. Like the corporate CDS market, the LCDS market is becoming more liquid than the market for cash loans.

However, the LCDS market does face challenges. First, several factors make LCDS an imperfect substitute for cash loans. For example, loans can be prepaid, while LCDS have a fixed maturity. Some LCDS may be cancelled if the underlying reference obligation is prepaid and a deliverable obligation no longer exists. Holders of cash loans may receive fees from distressed borrowers in return for waiving covenants, but LCDS holders do not. Also, loan investors have voting rights in case of a restructuring, while LCDS holders do not. Second, important differences between LCDS trading conventions in Europe and the United States have reduced market liquidity. These include whether the LCDS references a particular loan

(Europe) or any senior secured loan of a particular issuer (United States), whether restructuring is included as a credit event (it is in Europe but not in the United States), and whether the LCDS is cancelled when the underlying loan is prepaid or refinanced (European LCDS are more likely to be cancelled than United States). Going forward, market participants expect the different cancellability provisions to converge on the US standard, while they expect the different treatment of restructuring as a credit event to persist.

### **Loan CDS indexes and index tranches**

Following the lead of investment-grade corporate credit derivative indexes, credit derivative indexes were introduced into the loan market in 2007 and have grown rapidly. In the United States, the LCDX index was launched in May 2007. It references 100 US LCDS at a five-year maturity. Trading volume in the LCDX has grown rapidly since its launch, with hedge funds reportedly accounting for 60–70 percent of trading volume. In October 2007, dealers introduced tranches on the LCDX. If a liquid market develops for LCDX tranches, it should facilitate the growth of the synthetic CLO market in the same way that the market for CDS tranches has for corporate synthetic CDOs.

The iTraxx LevX index references 35 European LCDS at a five-year maturity and was launched in October 2006. There are separate LevX indexes for senior and subordinated loans. However, the differences in LCDS documentation between Europe and the United States have reportedly reduced the level of investor interest in the LevX, and it is much less liquid than the LCDX.

## **A.3 CRT for asset-backed securities**

### **ABS CDOs**

CRT in the ABS market has been another major area of growth since 2005. As Figure A.1b showed, CDOs that invest in asset-backed securities, so-called ABS CDOs, grew nearly as fast as CLOs from 2004 through the first half of 2007. Before 2004, the market for ABS CDOs was small, and ABS CDOs held diversified portfolios across a range of ABS asset classes. Beginning in 2005, ABS CDOs' underlying portfolios became increasingly concentrated in RMBS, particularly US subprime RMBS, with a minority of the portfolio invested in tranches of other CDOs. A minority of ABS CDOs, so-called CMBS CDOs, invest entirely in commercial mortgage-backed securities (CMBS).

The recent crop of ABS CDOs are usually divided into two groups based on the quality of their collateral: "high grade" ABS CDOs invest in collateral rated AAA-A, while "mezzanine" ABS CDOs invest in collateral predominantly rated BBB. Figure A.5 shows the typical collateral composition of high grade and mezzanine ABS CDOs.

Before 2005, the portfolios of ABS CDOs were mainly made up of cash securities. But since then, most ABS CDOs have allowed a share of the portfolio to be made up of CDS referencing individual ABS, so-called synthetic exposures. The share of synthetic exposures has increased over time, and some ABS CDOs are entirely synthetic.



Figure A.5

**Typical collateral composition of ABS CDOs**

Percent

	<b>High grade ABS CDO</b>	<b>Mezzanine ABS CDO</b>
Subprime RMBS	50	77
Other RMBS	25	12
CDO	19	6
Other	6	5

Source: Citigroup

Figure A.6 reports rough calculations of the amount of BBB-rated subprime RMBS issuance over 2004–07 and the exposures of mezzanine CDOs issued in 2005–07 to those vintages of BBB-rated subprime RMBS. The figure shows that mezzanine CDOs issued in 2005–07 used CDS to take on significantly greater exposure to the 2005 and 2006 vintages of subprime BBB-rated RMBS than were actually issued. This suggests that the demand for exposure to riskier tranches of subprime RMBS exceeded supply by a wide margin.

Figure A.6

**BBB-rated subprime RMBS issuance and exposure of mezzanine ABS CDOs issued in 2005–07 to BBB-rated subprime RMBS**

USD billions

	<b>Subprime RMBS vintage</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
BBB-rated subprime RMBS issuance	12.3	15.8	15.7	6.2
Exposure of mezzanine ABS CDOs issued in 2005-07	8.0	25.3	30.3	2.9
Exposure as a percent of issuance	65	160	193	48

Source: Federal Reserve calculations

The underlying assets of an ABS CDO are themselves RMBS tranches on diversified pools of mortgages. For this reason, an ABS CDO is a “two-layer” securitisation - a securitisation that invests in securitisations. In contrast, corporate CDOs and CLOs are “one-layer” securitisations with exposures directly to the debt of corporate issuers. Another type of “two-layer” securitisation that was discussed in the 2005 report is a “CDO-squared,” which is a CDO that invests in other CDO tranches. The subset of CDO-squared transactions that concentrated their portfolio in ABS CDO tranches are, not surprisingly, performing just as poorly as the ABS CDOs themselves in the current market turmoil.

Because ABS CDOs are two-layer securitisations, the risk characteristics of ABS CDOs are complicated, as Appendix C discusses in more detail. The diversification of RMBS pools means that losses on RMBS will be driven by systematic, economy-wide risk factors. ABS CDOs are therefore designed to perform well in most circumstances but to suffer steep

losses during times of system-wide stress. The tranching of ABS CDO liabilities ensures that ABS CDO investors are exposed to an “all or nothing” risk profile that depends on the level of the system-wide stress. Small differences in the level of system-wide stress can have large effects on the losses suffered by individual ABS CDO tranches. The “all or nothing” character of a tranche’s risk profile is more prominent for more senior tranches.

The performance of ABS CDOs during the current market turmoil is discussed in detail in section 3.2.

### **CDS on ABS**

Another development is the growing use of CDS whose underlying reference obligation is an ABS, including RMBS, commercial mortgage-backed securities (CMBS), and CDOs. Following the introduction of standardised documentation for CDS on ABS by ISDA in June 2005, CDO managers began using CDS on ABS to source assets for ABS CDOs. As discussed above, so-called hybrid ABS CDOs, whose collateral pool consists of both cash and synthetic positions, were a fast-growing part of the ABS CDO market in 2006 and 2007, and some ABS CDOs were entirely synthetic. The notional amount of CDS on ABS outstanding at year-end 2006 was estimated at \$800 billion. Because each CDS on ABS references a single ABS security, the market remains fragmented and illiquid. CDS on ABS inherit the illiquidity of the underlying ABS and are equally difficult to value.

Settlement for CDS on ABS works differently than settlement for corporate CDS and poses unique risks. While the traditional cash and physical settlement options are available for CDS on ABS, a “pay as you go” settlement has become the market convention. Under “pay as you go” settlement, the CDS contract is not closed out when a credit event occurs. Instead, the contract stays in force and the protection seller makes payments to the protection buyer to cover interest or principal payments on the underlying ABS that fall short of their contractual amounts. The ISDA documentation for “pay as you go” settlement of CDS on ABS has gone through several revisions since June 2005. An increase in defaults on subprime RMBS and ABS CDOs will test the robustness of this documentation, including how different revisions of the “pay as you go” settlement language interact with one another.

### **Indexes on ABS**

Using CDS on ABS as a building block, dealers launched the ABX index in January 2006. The ABX references a portfolio of CDS on 20 large subprime RMBS transactions that were issued during a six-month period. The ABX contains separate sub-indexes for AAA, AA, A, BBB, and BBB- rated subprime RMBS tranches. The ABX index was an immediate success upon its launch, and a robust two-way market quickly emerged between investors (including CDO managers) seeking to take on subprime credit risk and investors with a negative view of the US housing market looking to short subprime credit risk. The various sub-indexes made it possible for hedge funds and others to do relative-value trades across different parts of the capital structure, or to implement long-short strategies between individual subprime RMBS and the index. Still, the ABX never approached the level of liquidity found in the corporate CDS indexes (CDX and iTraxx).

During the market turmoil of 2007, the ABX index has been a visible marker of the growing distress of the subprime market. At the same time, the ABX has grown less liquid as the number of investors looking to take on subprime credit risk has shrunk. Although the regular six-monthly index roll is scheduled to take place in January 2008, it has been postponed because not enough subprime RMBS were issued in the second half of 2007 to fill a new index. As a result, the future of the ABX is in question.

Dealers launched a set of standardised tranches on the ABX index, named TABX, in February 2007. Just as the tranches on the CDX index are used by dealers to hedge exposures to corporate CDOs, the TABX tranches were designed to mimic the exposures of mezzanine ABS CDOs. Like the ABX, the TABX has been a data point for investors seeking to value illiquid ABS CDO positions during the recent turmoil.

The CMBX index referencing commercial mortgage-backed securities (CMBS) was created in March 2006. It references a portfolio of CDS on 25 CMBS deals with five sub-indexes: AAA, AA, A, BBB and BBB-. Like the ABX for the subprime RMBS market, the CMBX has served as a reference point for pricing in the CMBS market but has never approached the liquidity of the corporate CDS indexes. A European CMBX index (ECMBX) has been proposed for launch in 2008.

Section 4.3 in the main report discusses some of the issues that arose in recent months as the ABX index became an important reference point for valuations of exposures to ABS CDOs.

## **A.4 Market value products**

Unlike most structured CRT products that rely on the tranching of liabilities to reduce the risk for senior liability holders, a market value product relies on market-value triggers. When the market value of the underlying portfolio falls below a trigger threshold, the trading strategy changes to one aimed at protecting senior liability holders, typically requiring a deleveraging or liquidation of the portfolio. Structured investment vehicles (SIVs), constant proportion debt obligations (CPDOs), constant proportion portfolio insurance (CPPI), market value CDOs, and leveraged super-senior products are examples of market value products.<sup>37</sup>

Due to their market-value triggers, market value products are sensitive to the market and liquidity risk of the underlying portfolio (for example, a widening of credit spreads) as well as to default risk. The link to mark-to-market values inherent in a market value product makes these products more sensitive to market events than other CRT products that might have a similar underlying portfolio and similar rating but no market-value triggers. SIVs are one example: the senior debt of SIVs achieved AAA ratings based on the assumption that a rapid liquidation in the face of widening credit spreads could shield senior debt from losses. CPDOs are a second example: Appendix D explains in more detail how a CPDO works, how credit spreads on the CPDO's underlying portfolio are modelled to justify assigning a credit rating, and how CPDOs are likely to evolve.

The risks of market value products were highlighted in the summer of 2007. The rapid widening of credit spreads pushed many market value products to hit their triggers. Some were forced to liquidate, others were restructured and others, especially SIVs, drew on backup liquidity providers when short-term senior liabilities could not be rolled over. Even SIVs whose portfolios contain no subprime RMBS exposures had difficulty rolling over debt.

Rating agencies have tightened their rating criteria for market value products. One agency announced it will no longer give a rating higher than single-A to a market value product whose portfolio contains especially illiquid, complex, or volatile assets. If breaching a market

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<sup>37</sup> SIVs are discussed in more detail in section B.4 below.

value trigger would cause a market value product to unwind with little or no recovery expected, the rating would be capped at BBB.<sup>38</sup>

## **A.5 Experience since summer 2007**

Spreads widened on single-name CDS, corporate CDOs, CDS indexes and index tranches beginning in late July 2007 and have stayed at elevated levels. The CDS market remained reasonably liquid during the market turmoil of August 2007, especially at the 5-year maturity, while the cash bond market became noticeably illiquid. CDS trading volumes in August were up sharply, especially for index products. As shown in Figures A.1 and A.3, synthetic CDO and index tranches issuance dropped off sharply in the third quarter of 2007 as investors pulled back from structured credit products across the board.

Spreads also widened on LCDS, CLOs, the LCDX and LevX indexes and LCDX index tranches beginning in late July 2007 and have stayed at elevated levels. CLO issuance in the second half of 2007 slowed to roughly half the pace of the previous 18 months (Figure A.1b).

Section 3.2 discusses the recent performance of ABS CDOs in detail.

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<sup>38</sup> Fitch Ratings, *Market value structures: Exposure draft*, 18 December 2007.

## **Appendix B**

### **Developments in CRT participants**

The 2005 report discussed how and why banks, securities firms and insurance firms participated in the CRT market at that time. This section focuses on new developments since 2005.

#### **B.1 Banks and securities firms**

The largest banks and securities firms use CRT for three reasons:

1. To actively manage their own credit portfolios, including reducing concentrations.
2. To earn fees from originating, structuring and distributing CRT exposures (the “originate to distribute” model).
3. To earn revenue from market-making and trading of CRT exposures.

Market participants still believe that the logic motivating these business decisions was sound. Accordingly, they expect the CRT market to survive the current market turmoil and, eventually, resume its growth, though likely at a slower, more sustainable pace.

Apart from the largest dealer firms, banks continue to participate in CRT markets as end-users seeking a diversified range of credit risk exposures.

#### **Portfolio management**

As the 2005 report emphasised, CRT allows firms to take a more active approach to managing portfolios of credit risk. This motive for using CRT has not changed appreciably since 2005, but more and more banks now use active portfolio management strategies, and banks report hedging a larger share of their credit risk exposures. The 2005 report documented that, while nearly all banks reported using CRT to hedge their exposure to corporate credit risk, the percentage of total credit risk hedged was generally only in the single digits. In the interviews for this report, large banks reported hedging significantly larger shares of their large corporate credit exposure with CRT, as high as 25–50 percent.

#### **“Originate to distribute”**

Since 2005, the growth of CRT continues to provide banks and securities firms with opportunities to profit from originating, structuring and underwriting CRT products. They can earn fees while not having to hold the associated credit risk or fund positions over an extended time period. This has been termed the “originate to distribute” model.

Commercial banks and securities firms have reacted differently to the business opportunities presented by CRT. Commercial banks had traditionally originated credit assets in order to hold them on their balance sheet. The growth of CRT encouraged them to develop better distribution capabilities for credit products. For securities firms with established bond

distribution platforms, the growth of CRT pushed them to develop closer relationships with originators, including in some cases the acquisition of origination capacity, to improve access to a broader spectrum of credit assets. As a result, the growth of CRT and the “originate to distribute” model has led the business strategies of the largest commercial banks and securities firms to converge.

The growth of “originate to distribute” was one of the drivers behind the growth of CRT in the leveraged loan and ABS CDO markets, as noted above. It also drove growth in the riskier parts of the mortgage market in several countries, including the subprime mortgage market in the United States. Strong investor demand for credit exposures meant that banks and securities firms could originate (or purchase), structure, and distribute credit exposures that investors were willing to take on but that banks might have deemed too risky to hold on their own balance sheets for an extended period.

### **Proprietary trading and market-making**

Since 2005, revenue related to credit trading has risen strongly. Dealers have increased staffing and resources devoted to proprietary trading and market-making in CRT products accordingly. Of course, some of that growth has been reversed in recent months.

The proprietary trading and market-making desks at the large dealer firms have benefited from several factors.

- As noted in section A above, trading volumes in CRT products have grown tremendously since 2004. A market-maker’s profits will increase when trading volumes grow, if bid-offer spreads do not contract.
- Growing liquidity in CRT products has made a wide variety of trading strategies newly feasible, and proprietary trading desks at dealers are well-placed to engage in such strategies.
- The growing liquidity of the CRT market was supported by hedge funds, as noted in section B.4 below. This contributed to strong growth in dealers’ market-making and prime brokerage activities.

## **B.2 Insurers**

With a few exceptions, the activities of insurance companies, acting mainly as buy-and-hold CRT investors, have not changed materially since 2005. While many insurers reduced their credit derivative activity after experiencing losses in 2001 and 2002, many insurance companies are again active in these markets and overwhelmingly seek to obtain credit exposure, rather than actively trade credit risk. The exceptions are a few of the largest insurance holding companies who participate in a broader range of CRT market segments. For example, a few insurers have sought to leverage their credit skills by managing CDOs for other investors. Like other asset managers, they often work with an investment bank to structure and distribute these products. Often these broader CRT activities are conducted outside the regulated insurance company. For the smaller insurance companies, the rapid growth of structured credit products in the last few years has provided a means to obtain highly rated credit exposure (eg AA or AAA-rated products), as often required by their regulator or internal investment guidelines.

In response to a request from the Financial Stability Forum, the International Association of Insurance Supervisors conducts an annual survey of the global reinsurance market. The

most recent report, published in December 2007 and reporting on market conditions through 2006, shows that reinsurance firms had only modest participation in the CRT market. Reporting reinsurance firms held \$45 billion notional amount of credit derivatives and \$11 billion net amount of credit risk taken on through CDOs.<sup>39</sup> The IAIS stresses in its report that, although it believes the broad conclusions drawn from its reinsurance data are valid, the data have limitations. The data are a composite of reinsurance from different jurisdictions with different accounting standards and are compiled on a legal entity basis, not at the group level.

### **B.3 Pension funds**

Pension funds have participated in the CRT markets in a similar manner to insurance companies. As such, very few pension funds have developed independent trading operations for CDS, CDOs and other structured credit products. Pension funds generally participate in CRT markets indirectly by placing funds with traditional asset managers, special credit funds and hedge funds. Similar to insurers, such pension funds traditionally seek credit exposure, and thus seldom hedge existing positions or actively trade credit risk. As such, pension funds are largely passive, buy-and-hold investors in CRT products. They therefore provide capital for risk transfer activity but generally add little to secondary market liquidity.

### **B.4 Other nonbanks**

A variety of other nonbank financial institutions play a significant role in CRT activities. Increasingly, nonbanks provide a steady demand for credit products and seek a variety of credit exposures to satisfy their asset-liability management objectives. Accordingly, the business strategies and business models of nonbanks have evolved in order to participate in CRT markets, and in some cases to provide important market liquidity and even provide leadership for product innovations. In this section, we discuss the nonbank participants that have taken on a higher profile since 2005: asset managers, asset-backed commercial paper (ABCP) conduits and SIVs, and hedge funds.

#### **Hedge funds**

Hedge funds have become the most visible and active nonbank participants in CRT. In many cases their business models and strategies are specifically designed to participate in CRT activities. Indeed, the tremendous growth in hedge funds in recent years is not unrelated to the growth in CRT markets, the diversity of credit products, and the increasing disintermediation of traditional credit institutions in a variety of credit markets. A recent survey estimated that hedge funds represent approximately half of US trading volume in structured credit markets.<sup>40</sup> Because they are often early adopters of new CRT products, they provide liquidity and pricing efficiency to both new and established CRT instruments.

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<sup>39</sup> International Association of Insurance Supervisors, *Global Reinsurance Market Report 2007*, 12 December 2007. [http://www.iaisweb.org/view/element\\_href.cfm?src=1/3532.pdf](http://www.iaisweb.org/view/element_href.cfm?src=1/3532.pdf).

<sup>40</sup> *Hedge funds become the US fixed-income market*, Euromoney, September 2007, p. 10.

Many of the largest credit hedge funds have expanded into numerous product and trading areas, and are themselves multi-strategy funds with a credit focus. For example, among the larger credit hedge funds, a wide variety of trading strategies are present, such as whole loan and corporate bond trading, LBO financing, CDS trading, tranching products and CDO management, distressed debt and high yield activity, active index trading and hedging, a variety of “curve” strategies, correlation trading, and possibly even the trading of recovery rates.

Some specialist credit funds and credit hedge funds have evolved into credit derivative product companies, which are specialist firms that sell credit protection and are structured to obtain very high credit ratings (typically AAA). While one credit derivative product company was described in the 2005 report, today this model is more prevalent, either as a standalone enterprise or as part of a larger hedge fund group. In addition, whereas credit derivative product companies initially focused on trading single-name CDS, today such companies may be involved in both single-name and tranching CRT products.

Market participants expect hedge funds to remain active in CRT markets, to continue to be important contributors to CRT innovations, and to increasingly compete in a variety of CRT products with traditional credit intermediaries, such as commercial and investment banks. Indeed, many of these traditional financial institutions describe hedge funds as both clients and competitors who seek to disintermediate traditional banking institutions in a variety of credit activities, including direct lending.

### **Asset managers**

Three types of asset management firms participate in CRT markets:

1. Traditional asset managers have expanded the attention they pay to credit markets.
2. Specialised credit funds are designed to provide investors with actively managed long credit exposure. They employ some leverage (typically less than hedge funds), often do not actively hedge positions, and seldom develop short credit positions.
3. “Enhanced” money funds attract institutional, corporate and individual investors seeking short-term fixed-income returns, with daily or near daily liquidity. Unlike traditional money market funds, enhanced money funds invest in highly-rated CRT products (among other things).

These asset managers have contributed to the depth and scope of the CRT markets, including market liquidity (particularly in the primary market) and price efficiency. Traditional asset managers have been slower to make use of newer CRT products and only make limited use of credit derivatives and structured credit products to obtain or to adjust their credit exposures. Specialised credit investment funds use newer CRT products more heavily. A meaningful minority of these asset managers also use credit derivatives to hedge credit risk, most often to manage concentrations or to reflect a shift in their fundamental analysis relative to a benchmark.

Traditional asset managers and specialised credit funds have used their business models to participate on the “sell-side” of the CRT market as well, for example, by structuring and managing CDOs (and related structures). Often drawing upon their own asset portfolios, these fund managers typically work with insurance companies, pension funds and smaller banks to develop tailored structured credit products to meet specific investment objectives. This is often done in cooperation with an investment bank, which may provide the investors, and the fund manager will often manage the portfolio or structured product (eg a CDO).



Therefore, the business strategies and the fundamental business models of these diverse asset management companies have evolved in numerous ways to participate in a variety of CRT activities.

### **ABCP conduits and SIVs**

Some of the world's largest commercial banks sponsor asset-backed commercial paper (ABCP) conduits and structured investment vehicles (SIVs) that invested in CRT assets. Given the important role of banks in sponsoring and providing liquidity support to conduits and SIVs, it is not obvious whether conduits and SIVs should be discussed with banks or nonbanks. Here, we follow their legal form and discuss them with nonbanks.

ABCP conduits are special purpose companies that buy and hold financial assets and finance the purchase of assets by issuing ABCP. The ABCP conduits that participate in CRT markets are referred to as "securities arbitrage" or "hybrid" conduits. Commercial paper investors generally only invest in conduits whose commercial paper is fully backed by a liquidity support agreement, which may be provided by the conduit's sponsor or by a third party. These liquidity support agreements ensure that the commercial paper investors will be repaid if the conduit is unable to issue its commercial paper.

SIVs are leveraged investment companies that raise third-party capital and leverage this capital by issuing debt in the commercial paper and medium-term note markets. Unlike ABCP conduits, SIVs generally do not seek to have 100 percent of their liabilities covered by liquidity support agreements. Instead, they hold a small amount of liquidity support and enough capital for the SIV to unwind its portfolio without inflicting losses on debtholders. Rating agencies monitor the riskiness of the SIV's portfolio relative to its capital as a condition of maintaining the SIV's prime commercial paper rating.

Over the past several years, ABCP conduits and SIVs have been important purchasers of senior tranches in the CRT markets. They funded their investments in long-term CRT securities with short-term funding in the commercial paper and medium-term note markets. In this way they exposed themselves to the classic maturity mismatch that is typical of a bank: borrowing short-term and investing long-term. Like a bank, conduits and SIVs - and by extension the CRT market itself - were vulnerable to a run by debtholders. This proved to be a weakness in the market turmoil of 2007, as discussed in section 3.4 in the body of the report.

## Appendix C

### Understanding the credit risk of ABS CDOs

#### C.1 Introduction

ABS CDOs are collateralised debt obligations backed by pools of asset-backed securities (ABS) including residential and commercial mortgage-backed securities (RMBS and CMBS) and other CDOs.<sup>41 42</sup> Most ABS CDOs are classified as cash flow or hybrid structures. Cash flow CDOs are constructed to pay liabilities with interest and principal payments generated by cash investments in fixed income securities. Hybrid CDOs have exposure to fixed income securities through both cash investments and, synthetically, through credit default swaps. Functioning primarily as hold-to-maturity vehicles, cash flow/hybrid ABS CDOs are generally not sensitive to fluctuations in the market value of underlying collateral. They are designed to diversify the risks of the underlying assets and distribute payments to investors according to seniority and priority.

Elevated RMBS issuance and the standardisation of credit default swaps that reference RMBS bolstered CDO issuance in recent years. Global CDO issuance reached a peak \$551 billion in 2006 but dropped to \$487 billion in 2007. As shown in Figure C.1, global issuance of CDOs grew steadily from 2005 through the first half of 2007. Issuance fell precipitously during the second half of 2007, however, largely because of a decline in new ABS CDO deals.<sup>43</sup>

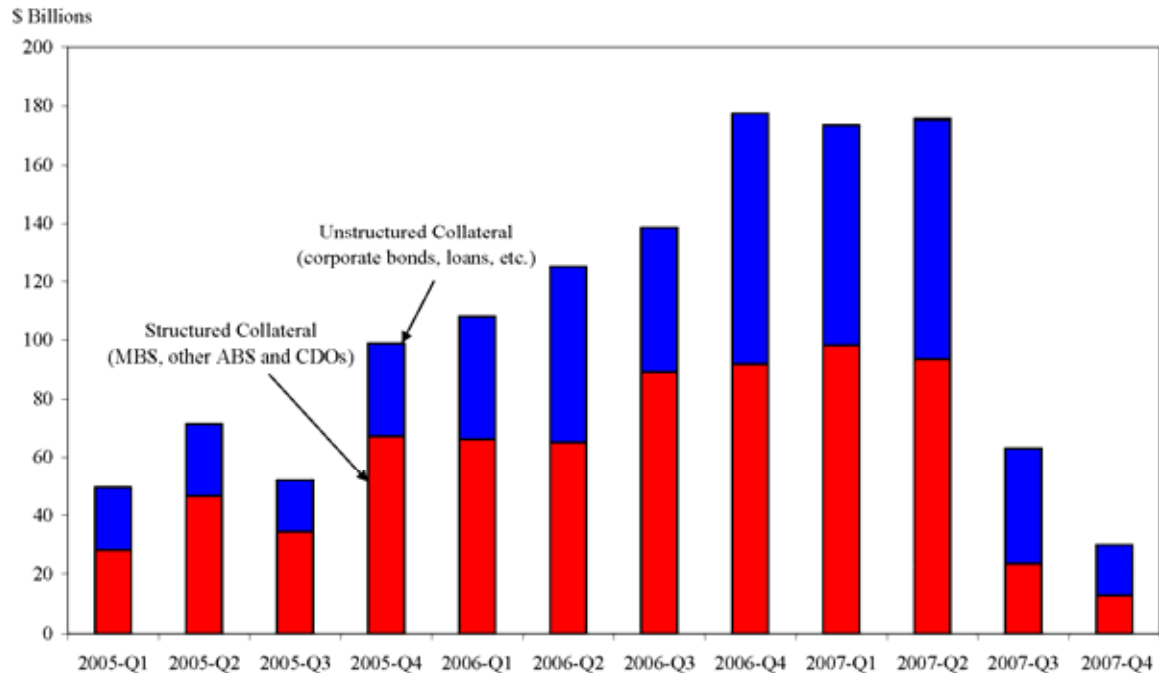
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<sup>41</sup> Throughout this appendix we use the term asset-backed securities (ABS) to refer to any fixed income security with cash flows tied to a pool of underlying assets. A much narrower definition of ABS that includes only pooled investment securities that are not backed by mortgages or corporate debt (eg credit card or automobile loan securitisations) is sometimes used in other contexts.

<sup>42</sup> This appendix was prepared by Erik Heitfield.

<sup>43</sup> Securities Industry and Financial Markets Association, Global CDO Market Issuance Data, 2007-Q4.

Figure C.1  
Global CDO Issuance, by Collateral Type



Source: Securities Industry and Financial Markets Association

Because of their concentrated exposure to subprime and other non-agency RMBS, recent vintages of ABS CDOs have experienced significant negative rating migrations. Figure C.2 summarises downgrade activity for recent vintages of US ABS CDOs rated by Standard and Poor's. Rating downgrades have been most prevalent in lower-rated tranches of recent-vintage CDO deals. Though downgrade rates for investment-grade CDO notes have been somewhat lower than for speculative-grade notes, downgrades of investment-grade notes are more significant because investment-grade notes comprise a much larger volume of total CDO issuance and because investors in these securities expect them to be particularly safe. As of November 25, 2007, about 9 percent of 2006-vintage and 14 percent of 2007-vintage S&P-rated investment-grade CDO tranches had been downgraded including about 5 percent of 2006-vintage and 6 percent of 2007-vintage tranches initially rated AAA.<sup>44</sup> Similar rating actions have been taken by Moody's and Fitch.

The very poor performance of recent ABS CDO vintages has led to concerns about the economic viability of these structures and about the ability of rating agencies to effectively evaluate and monitor their risks. This annex describes the economic drivers of ABS CDO credit risk and surveys rating agency quantitative models for evaluating ABS CDOs. This analysis suggests that to some extent dramatic changes in performance are inherent in the structure of ABS CDO deals. Because a typical CDO note's payouts depend in a nonlinear way on a diversified pool of underlying collateral, these notes can be expected to perform well under most conditions, but may experience significant losses during times of severe systematic stress. At the same time, deficiencies in rating agencies' quantitative credit risk

<sup>44</sup> These statistics and the data presented in Figure C.2 were compiled from Standard and Poor's ratings data published on [www.cdointerface.com](http://www.cdointerface.com).

models may have meant that CDO ratings were slow to adjust to deteriorating collateral quality, meaning that particularly large downward rating adjustments were needed once the impairment of ABS CDO collateral was broadly recognised.

## C.2 Factors Affecting ABS CDO Credit Performance

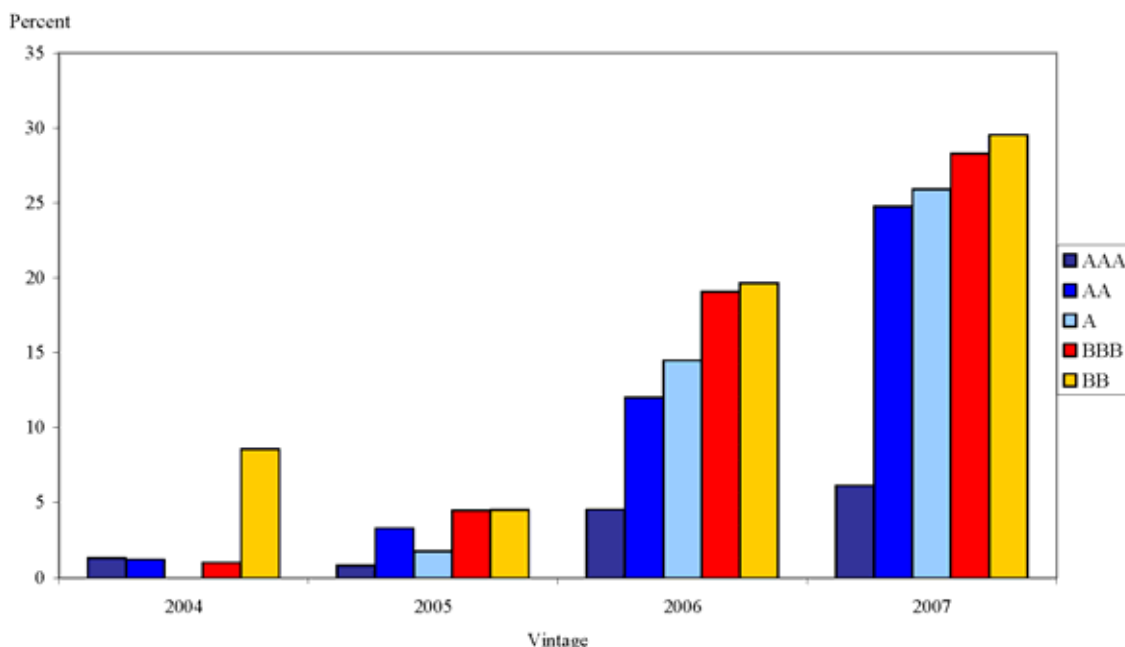
This section describes the economic drivers of ABS CDO credit performance. Where possible, results are illustrated using Monte Carlo simulations of hypothetical ABS CDO deals.

In some respects, CDO notes are similar to more traditional “plain vanilla” debt instruments such as corporate bonds. A CDO’s assets generate cash flows used to repay debt, and in distributing available cash flows the interests of more junior investors are subordinated to those of more senior debt holders. As with “plain vanilla” debt, one can evaluate the credit quality of CDO notes by asking two broad questions:

1. will the cash flows generated by the CDO’s assets be sufficient to cover contractual obligations to debt-holders, and
2. how do the terms of a given CDO note and the structure of the CDO’s liabilities affect the distribution of payouts to investors when cash flows from assets are insufficient to satisfy all contractual obligations?

Figure C.2

### Share of US ABS CDO Notes Downgraded, by Initial Rating and Vintage



Data as of 25 November 2007

Source: Standard and Poor's

The complexity of most CDO deals poses significant challenges for analysing the credit quality of CDO debt notes. On the asset side, an ABS CDO holds a diverse pool of fixed income securities. Evaluating a CDO's future cash flows requires understanding how each of its assets will perform individually and in combination with all other assets in the collateral pool. On the liability side, the typical CDO's capital structure is quite different from that of a typical corporation. Most CDOs issue very little equity relative to assets and it is not uncommon for a single CDO to issue ten or twenty different classes of debt.

### Asset-Side Risk Drivers

A typical ABS CDO may hold cash or synthetic investments in 100 or more asset-backed securities, including RMBS or even other CDO notes. ABS CDOs are described as "high grade" or "mezzanine" depending on the quality of the collateral held by the CDO. High-grade ABS CDOs generally hold securities rated A- and higher, while mezzanine ABS CDOs are primarily backed by BBB-rated securities. RMBS held by a high-grade CDO may have higher ratings either because they reference higher quality mortgages (eg Alt-A rather than subprime), or because they have better credit enhancement (eg higher seniority in the RMBS deal structure), or both. As shown in Figure C.3, recent vintages of ABS CDOs in general, and mezzanine CDOs in particular, have been heavily invested in RMBS backed by subprime mortgages.<sup>45</sup> Because an ABS CDO is a securitisation whose assets come from other securitisations, it is an example of a "two-layer" securitisation, also referred to as a re-securitisation.

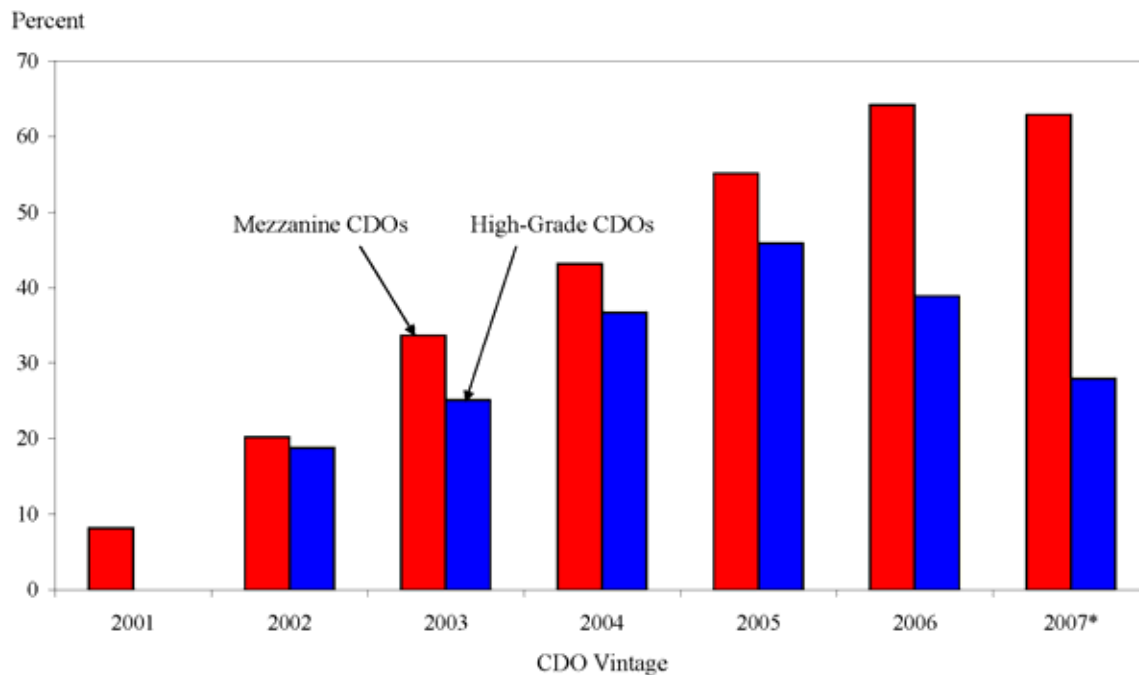
CDOs are designed to diversify risk. The laws of probability imply that the average credit performance of a pool of similar assets will be less volatile and more predictable than the performance of a typical asset in the pool. Indeed, if the pool consists of a large number of relatively small assets, uncertainty in the pool-wide credit loss rate will arise almost entirely from correlations in default losses across assets. In this setting, idiosyncratic risk is diversified away. Only systematic risk factors that influence many assets at once are likely to influence pool-wide credit losses. This does not mean that average losses for the pool will be lower than the expected loss for a typical asset in the pool, but it does mean that average pool-wide losses will be more stable and pool losses will tend to be more highly correlated with economy-wide risk drivers.

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<sup>45</sup> The data in Figure C.3 are reported in *The Effect of Mortgage Market Stress on US CDO Ratings in Third-Quarter 2007*, Standard and Poor's CDO Spotlight, 16 October 2007. While these data only reflect deals rated by S&P, similar information published by other rating agencies confirms that recent ABS CDOs are heavily concentrated in subprime RMBS. See also, *The Impact of Subprime Residential Mortgage-Backed Securities on Moody's-Rated Structured Finance CDOs: A preliminary Review*, Moody's Structured Finance Special Comment, 23 March 2007, and *Rating Stability of Fitch-Rated Global Cash Mezzanine Structured Finance CDOs with Exposure to US Subprime RMBS*, DerivativeFitch Structured Credit Special Report, 2 April 2007.

Figure C.3

**Share of Cash flow/Hybrid CDO Collateral Backed by Subprime Mortgages,  
by CDO Type and Vintage**



\* 2007 vintage includes deals completed through September

Source: Standard and Poor's

Figure C.4 shows the effects of risk diversification on CDO collateral pool performance by comparing the distribution of simulated returns for two hypothetical mezzanine ABS CDO collateral pools. The first CDO is invested equally in 100 mezzanine RMBS tranches while the second CDO is invested in 10 mezzanine RMBS tranches. By construction, both collateral pools have an expected net return of zero, but the distribution of realised returns for the diversified pool is much more tightly clustered around this expected level.<sup>46</sup> In general, payouts from a given RMBS note depend on both systematic risk drivers that affect all mortgages such as nationwide house price appreciation and interest rates, and idiosyncratic drivers specific to the mortgage pool in question such as the underwriting standards of the mortgage originator and the effectiveness of the mortgage pool servicer. In the undiversified CDO example, both types of factors affect returns for the collateral pool. In the diversified CDO example, idiosyncratic factors associated with individual RMBS exposures tend to cancel one another out so that pool-wide returns are less volatile.

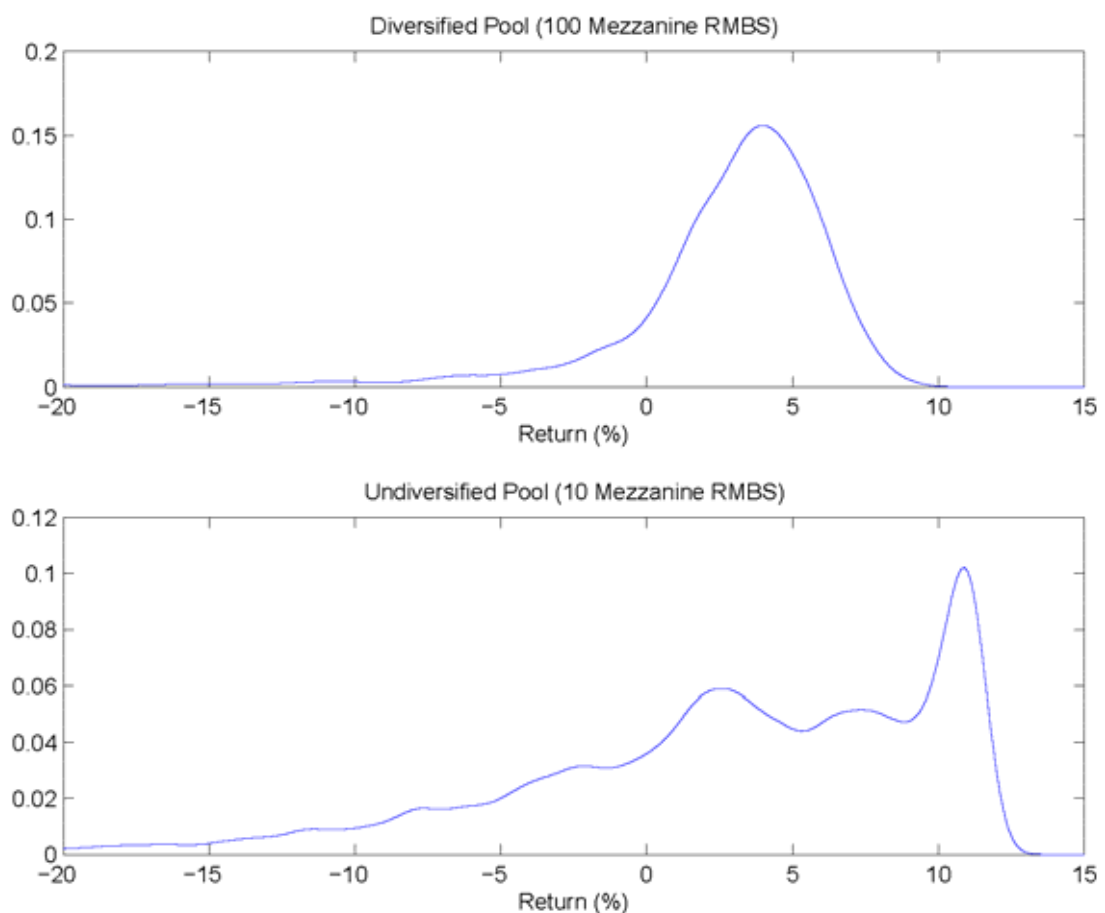
Asset quality can also affect the distribution of collateral pool returns. All else equal, collateral returns for high-grade ABS CDOs should be less volatile than those for mezzanine CDOs. Lower rated securities held by mezzanine CDOs pay higher interest rates but they are more likely to experience credit losses during times of systemic stress. Figure C.5 illustrates how the seniority of RMBS collateral can influence pool performance. This example compares two pools of 100 RMBS. The “mezzanine” collateral pool consists of 100 low-rated RMBS notes

<sup>46</sup> In this and all subsequent examples, ‘return’ is defined as the net present value of an investment per unit of currency invested. Future cash flows are discounted using an assumed risk-free rate of five percent.

that have relatively little credit enhancement. The “high-grade” pool consists of 100 RMBS on the same underlying mortgages that have significantly greater credit enhancement. In each case the interest rate spreads paid on the mortgage securities are set to exactly cover expected credit losses so that both pools have an expected net return of zero.<sup>47</sup> If economic conditions turn out to be favourable, realised yields on the pools will be close to the mortgage securities’ contractual rates, so the mezzanine pool will have a higher realised return than the high-grade pool. On the other hand, because they have less credit enhancement, the mezzanine mortgage securities are more likely to experience significant credit losses during unfavourable economic conditions. As a result, the distribution of realised returns on the mezzanine RMBS portfolio is significantly more spread out than that for the high-grade portfolio.

Figure C.4:

**Simulated Return Distributions for Diversified and Undiversified Collateral Pools**



<sup>47</sup> The RMBS in the mezzanine pool each have an attachment point of 10 percent and pay a contractual interest rate spread of 440 basis points. The RMBS in the high-grade pool each have an attachment point of 20 percent that pay a contractual interest rate spread of 60 basis points.

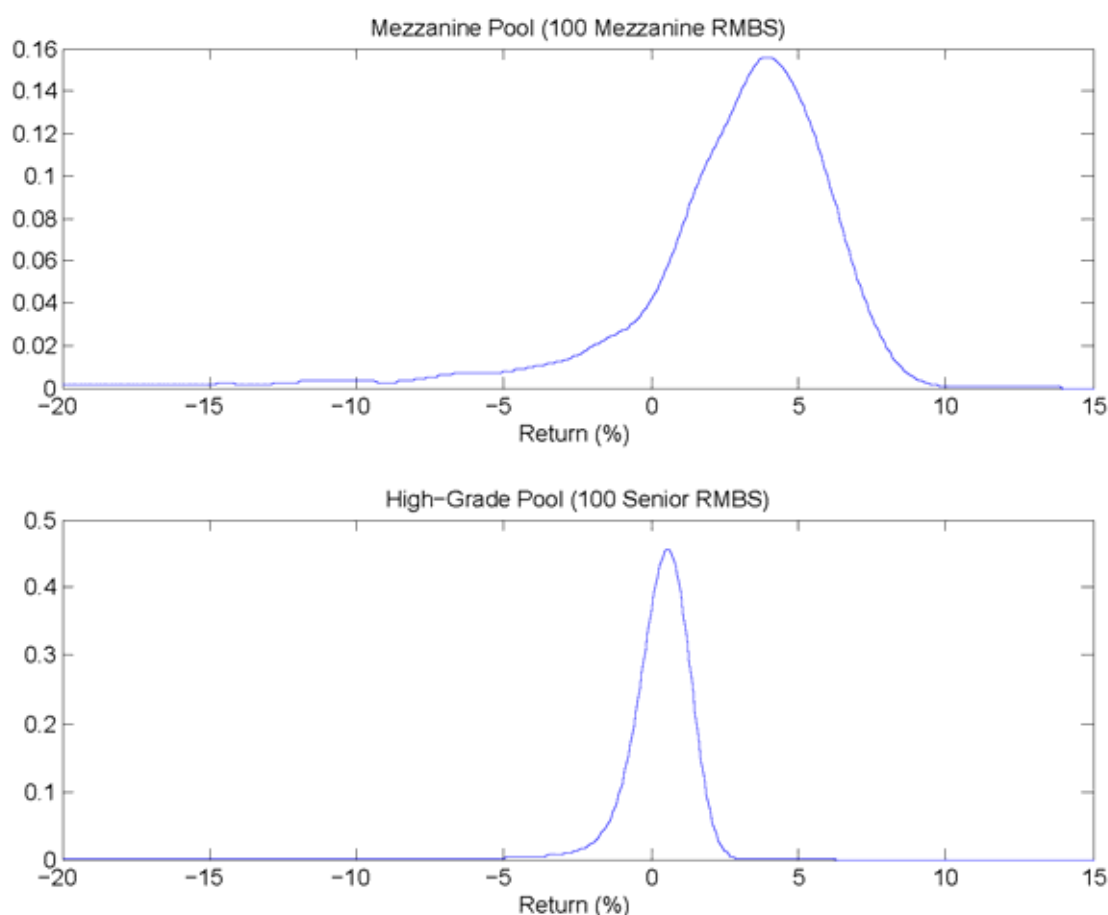
## Liability-Side Risk Drivers

The performance of a given CDO note is strongly influenced by its position in the CDO capital structure and by any external credit enhancements embedded in the CDO deal such as third-party guarantees. The more senior a CDO tranche, the higher priority are its investors' claims on cash flows from the asset pool. A note's position in a CDO deal's capital structure is commonly summarised by its attachment point. This is roughly the percentage of losses that the CDO collateral pool can incur before note-holders will face credit losses.

A CDO deal's capital structure is intimately linked to the volatility of collateral returns. In general, the less volatile are collateral returns around their expected level, the less protection is needed for a given CDO note to achieve a target rating. A CDO note backed by lower-rated mezzanine RMBS collateral, for example, will tend to have more subordinated debt and equity below it than a comparably rated CDO note backed by senior RMBS collateral. As shown in Table C.1, high-grade ABS CDO notes typically have lower attachment points than mezzanine ABS CDO notes with the same ratings. As a result, the credit quality of a given CDO note may bear scant relation to the credit quality of the collateral pool backing it.

Figure C.5

### Simulated Return Distributions for Mezzanine and High-Grade Collateral Pools



CDO notes are unlikely to incur losses if collateral performs at, or even somewhat below, expectations. On the other hand, if the collateral pool significantly under-performs, junior tranches may sustain severe losses as cash flows are diverted to repay more senior investors. Table C.2 illustrates how the structuring of CDO liabilities influences CDO note performance. Each row of the table describes the distribution of simulated returns for



tranches of a hypothetical CDO deal backed by 100 mezzanine RMBS. Figure C.6 shows the marginal distribution of returns for the collateral pool and selected debt tranches. As with our earlier examples, contractual interest rates are chosen so that each investment has an expected net return of zero. It is instructive to compare each tranche's median return with lower percentiles of its simulated return distribution. In most circumstances the more senior tranches have lower realised returns than the more junior tranches because they carry lower contractual interest rates, but these more senior tranches are also more likely to be fully repaid when collateral losses are high. The greater a note's seniority, the lower is the probability that it will experience credit losses. Note, however, that in extreme cases even quite senior tranches may experience significant losses.

Table C.1  
**Capital Structure for Typical 2006-vintage ABS CDOs**  
Percent of notional

<b>CDO Tranche Rating</b>	<b>High-grade ABS CDO</b>	<b>Mezzanine ABS CDO</b>
Sr. AAA	11 - 100	34 - 100
Jr. AAA	6 - 11	20 - 34
AA	3 - 6	12 - 20
A	2 - 3	9 - 12
BBB	1 - 2	4 - 9
Unrated	0 - 1	0 - 4

Source: *Rating Actions: Something Had to Give*, Morgan Stanley CDO Market Insights, 16 July 2007

### Effects of Systematic and Idiosyncratic Risk

CDO note credit performance depends on a combination of systematic and idiosyncratic factors. Recall that systematic risk factors affect all or most collateral assets simultaneously while idiosyncratic factors affect the performance of individual collateral assets. Figure C.7 illustrates how these factors influence CDO note returns. Each panel of the figure shows realised returns for a particular CDO note plotted against realised values of a simulated systematic risk factor. Values of the systematic factor toward the left end of a horizontal axis correspond to adverse economy-wide shocks such as falling house prices. The CDO collateral pool in this simulation consists of 100 mezzanine RMBS. Because the collateral pool is not perfectly diversified, idiosyncratic factors such as RMBS servicer quality may have a nontrivial effect on overall pool returns.

Table C.2  
**Hypothetical ABS CDO Deal Backed by 100 Mezzanine RMBS**

Tranche	Percent of Notional	Interest Spread (b.p.)	Median	Net Return (percent)		
				10th Percentile	5th Percentile	1st Percentile
Debt A	50 - 100	43	1	1	1	-38
Debt B	45 - 50	120	2	2	2	-100
Debt C	40 - 45	130	3	3	3	-100
Debt D	35 - 40	140	3	3	3	-100
Debt E	30 - 35	150	4	4	4	-100
Debt F	25 - 30	155	5	5	4	-100
Debt G	20 - 25	165	6	5	-48	-100
Debt H	15 - 20	170	7	6	-100	-100
Debt I	10 - 15	180	8	7	-100	-100
Debt J	5 - 10	200	10	-29	-100	-100
Equity	0 - 5	n.a.	12	-100	-100	-100

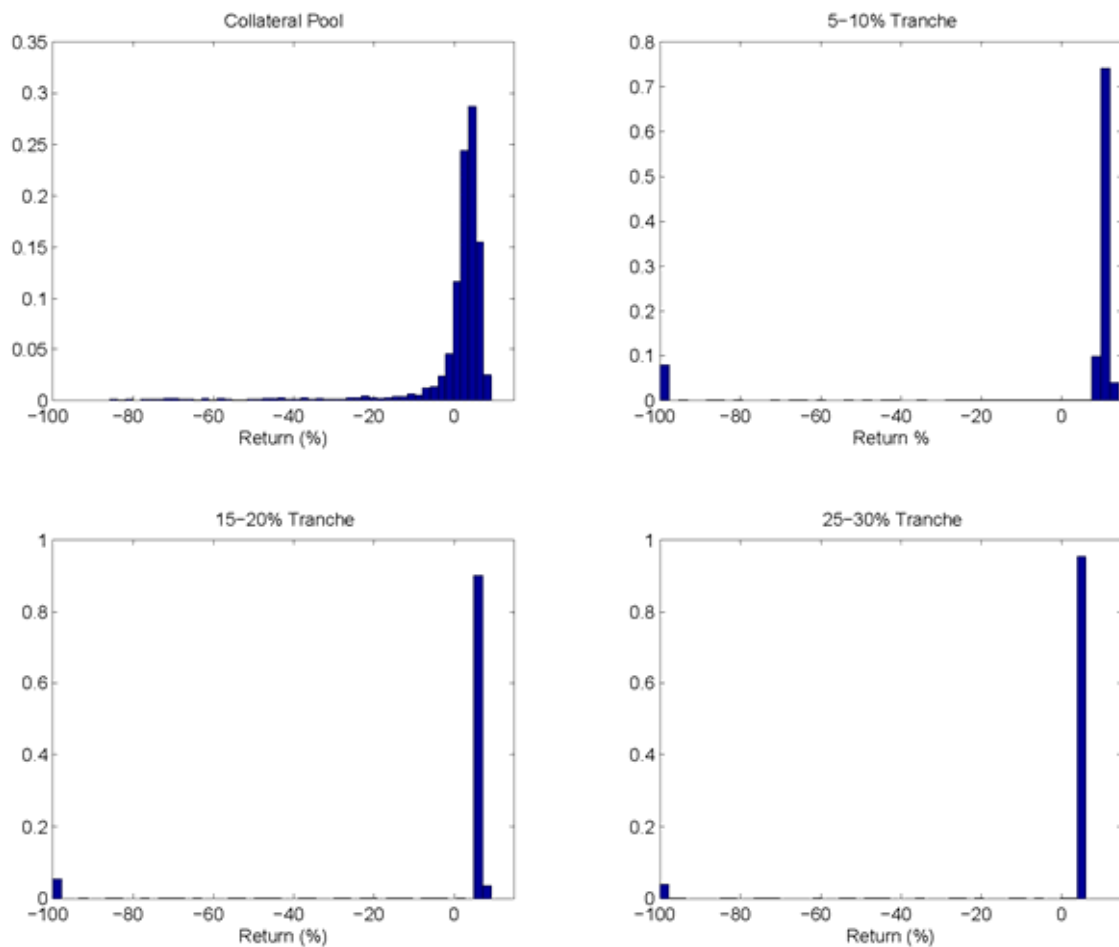
Note: The data in this table are intended for illustrative purposes only. Typical ABS CDO deals are not fully concentrated in RMBS. Furthermore, key parameters used in this simulation were not empirically estimated.

The most striking feature of Figure C.7 is the “cliff effect” associated with more senior CDO debt notes. Though collateral returns are smoothly increasing in the systematic factor, senior tranche returns are nearly constant at a small positive return for most realisations of the systematic factor but drop off precipitously for low values of the systematic factor. In other words, these notes can be expected to perform well under most conditions, but in times of severe systematic stress they may incur exceptionally large losses.

This example also illustrates how idiosyncratic and systematic risk factors interact with a CDO’s capital structure. As can be seen in the upper left panel, collateral returns are positively correlated with the systematic factor, but this correlation is not 100 percent. If the collateral pool was perfectly diversified all simulated returns would lie on an upward-sloping curve. The “cloud” of points in this panel arises from the effects of idiosyncratic risk factors on collateral performance. Comparing the top two panels with the bottom two panels, one observes that idiosyncratic factors have less influence on the performance of more senior debt notes. These notes only incur losses when collateral losses are exceptionally high. Very high collateral losses could arise as a result of adverse systematic shocks, but they are quite unlikely to arise from an unlucky combination of idiosyncratic shocks. Thus, all else equal, more senior CDO notes tend to be relatively more sensitive to severe systematic shocks.

Figure C.6

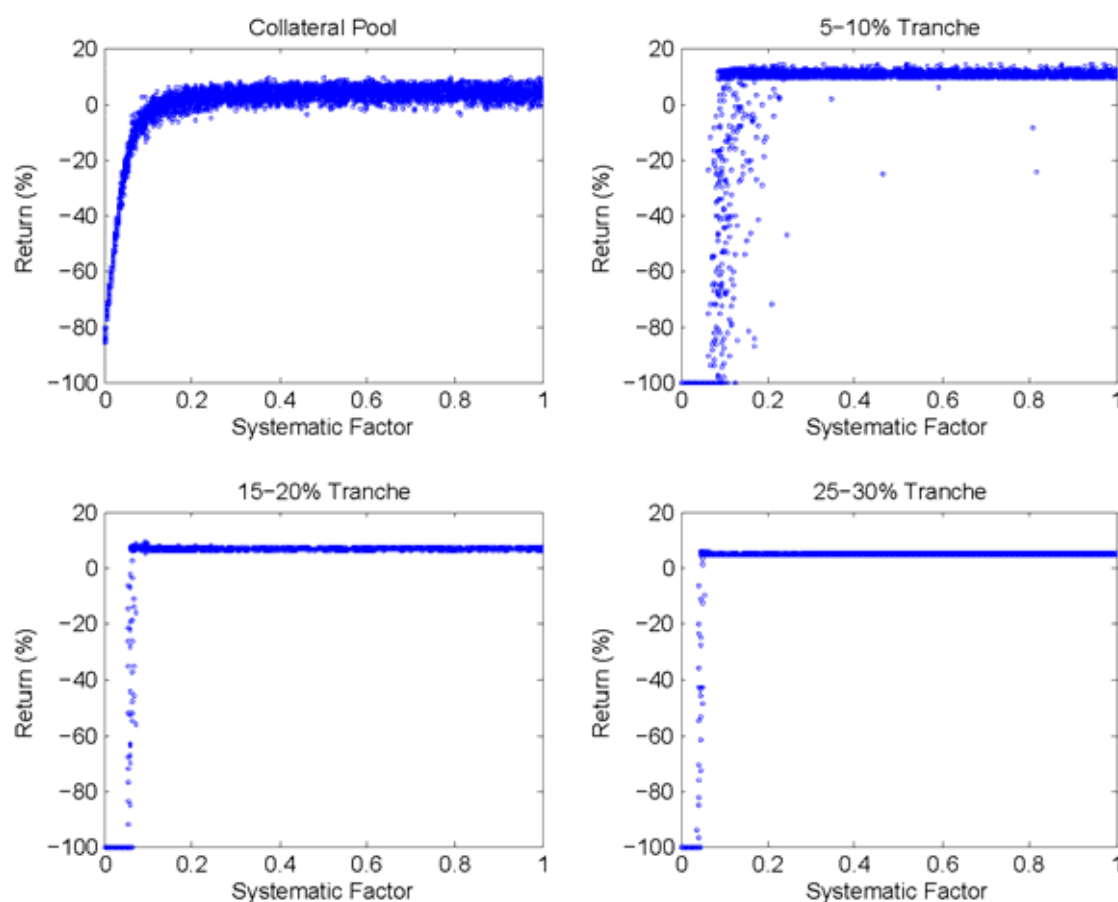
**Simulated Return Distributions for Collateral Pool  
and Debt Tranches of a Mezzanine CDO**



An implication of the preceding discussion is that CDO debt notes can be expected to perform well in most circumstances, but they are most likely to experience significant credit losses during times of system-wide stress when diversified collateral pools perform most poorly. Because tranche losses depend on collateral performance in a nonlinear way, CDO note credit quality can deteriorate rapidly as underlying collateral becomes impaired. More senior CDO notes are better protected from the effects of adverse idiosyncratic and systematic shocks than more junior notes, but the performance of more senior CDO notes tends to be more highly correlated with systematic risk factors.

Figure C.7

### Effects of Systematic Shocks on Returns for Collateral Pool and Debt Tranches of a Mezzanine CDO



## C.3 The ABS CDO Rating Process

In rating CDOs and other structured credit products, Moody's, S&P and Fitch rely to a great extent on quantitative credit risk models. To be sure, the ratings implied by these models are subject to credit committee review and the agencies report that credit committees do occasionally adjust model-implied ratings. Nonetheless, quantitative models represent the most important input into the CDO rating process. An examination of the structure and assumptions embedded in these models provides insights into how the rating agencies view CDO credit risk. As noted at the end of this section, rating agencies currently have their CDO rating methodologies under review and changes may be forthcoming.

In determining a CDO note's rating, each agency combines information on the collateral asset pool and CDO deal structure provided by the deal arranger with its own statistical models and analytic methods. The three agencies take broadly similar approaches. First, they simulate the performance of the asset pool backing the CDO. Next, statistics generated by the simulation are used to examine how cash flows from the asset pool will be apportioned among CDO tranches under different scenarios. Finally, each agency compares the results of its cash flow analysis to existing benchmarks and standards to assign ratings.

## Simulating Collateral Losses

The three agencies use similar input data in their pool loss simulations. For ABS (including RMBS) collateral, these data include the security's credit rating, position in the ABS deal capital structure, expected maturity and ABS type (eg prime RMBS, subprime RMBS, credit card receivables, etc.) A probability of default is assigned to each asset based on its type, rating and maturity. For corporate bonds, default probabilities have been estimated from long-run default studies conducted by the agencies. It is not clear whether similar research informs ABS default probabilities. S&P and Fitch assume lower default probabilities for ABS assets than for comparably rated corporate debt. An estimate of the asset's recovery rate in the event of default is also imputed. Recovery parameters appear to be largely judgmental. In general, more junior ABS tranches have lower assumed recovery rates, as do "thinner" tranches that comprise a smaller share of the ABS deal. Among the three agencies, only Fitch assumes that recovery rates on ABS will be lower under conditions when default rates are exceptionally high. This is important, since if recovery rates are negatively correlated with realised default rates, failure to account for this correlation can cause models to understate collateral pool losses during systematic stress conditions.

Assumptions about the correlation of defaults across assets within a collateral pool are critical to modelling the distribution of pool losses. For example, if defaults are assumed to be largely independent across assets, then simulated losses will be tightly clustered around the expected pool loss rate. Conversely, high correlation implies a thicker tailed portfolio loss distribution, meaning that simulated pool losses under stress conditions may significantly exceed expectations. All three rating agencies use variants of what is called the normal copula model to describe dependence in defaults among pool assets. This model is derived from early work by Merton on the valuation of corporate debt securities.<sup>48</sup> It assumes that a firm defaults when the value of its assets falls below a critical parametric threshold. A firm's asset value depends on a combination of normally distributed idiosyncratic risk factors that are unique to each firm and normally distributed systematic factors that affect many firms simultaneously. Common exposure to systematic risk factors leads to correlations in defaults across firms.

## Rating CDO Tranches

Once the distribution of collateral pool credit losses has been simulated, any number of statistics on the performance of the collateral pool can be calculated. The rating agencies use such statistics to assess how each tranche of a CDO deal is likely to perform under a variety of conditions. For cash flow or hybrid CDOs of ABS, both the timing and the level of pool credit losses can affect how cash flows are apportioned among tranches.

S&P and Fitch compute cumulative percentiles of the simulated portfolio loss distribution for separate "rating scenarios" associated with each rating notch. Higher-grade rating scenarios correspond to less likely, but more severe, pool loss rates. For each tranche of a CDO deal, these agencies also determine the lowest pool loss rate at which the tranche would be unable to repay investor principal and/or make contractually-obligated interest payments. In computing this breakeven pool loss rate, a range of scenarios involving different prepayment speeds, default timing and interest-rate paths are considered. A tranche is assigned the rating for the highest rating scenario pool loss percentile that does not exceed its breakeven

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<sup>48</sup> Merton, R.C. (1974), *On the pricing of corporate debt: the risk structure of interest rates*, *Journal of Finance*, 29, p. 449-470.

pool loss rate. In this way, S&P and Fitch seek to peg CDO note ratings to estimates of the likelihood that the note will fully repay principal and interest.

Moody's takes a different approach, reflecting its different rating criteria. Rather than working with the simulated pool loss distribution directly, Moody's estimates a simplified parametric loss distribution called the correlated binomial model (CBM). This model is derived under the assumption that pool assets are equal sized and have the same default probabilities, recovery rates and asset-value correlations. Parameters for the CBM are estimated with a statistical moment-matching procedure designed to ensure that characteristics of the fitted CBM distribution are close to those of the simulated portfolio loss distribution. The CBM is used to compute expected losses for each tranche of the CDO deal under fast, medium and slow prepayment scenarios. The expected loss used for rating purposes is a weighted average of these three estimates. Moody's determines a CDO note's rating by comparing its estimated expected loss with benchmarks for each rating grade.

### Revisions to Rating Agency Models

Although the economics of securitisation can explain why CDO downgrades tend to be large in magnitude and clustered together, certain assumptions in the rating agencies' quantitative models may have made them slow to adjust to the effects of deteriorating CDO collateral.

- The agencies' models rely on collateral credit ratings to convey information about the expected likelihood and severity of collateral losses, so any deficiencies in the agencies' processes for rating assets backing CDOs are likely to flow through to CDO ratings.
- The agencies' portfolio loss simulations do account for correlations in defaults across assets within a collateral pool, but the statistical models used to describe this correlation may not fully capture the likelihood of extreme pool loss events, and, in some cases, key parameters of these models are not empirically derived.
- The agencies appear to rely on ad hoc scenarios, rather than empirical analysis, to examine the effects of collateral loss timing, prepayment rates and other factors on the distribution of collateral cash flows among CDO tranches.

All three rating agencies have recently announced changes to their quantitative rating models designed to make ratings for newly-issued CDO notes more conservative. These adjustments generally involve increasing assumed default probabilities and asset correlation parameters for recent vintages of RMBS collateral.<sup>49</sup> These adjustments can be expected to result in higher simulated loss rates for new CDO collateral pools so that, all else equal, a CDO note will need to have more credit enhancement to achieve a given rating. Increasing collateral default probabilities will affect required credit enhancement levels for all CDO tranches, while increasing correlation assumptions will disproportionately affect senior tranches. By increasing default probability parameters for RMBS collateral on watchlist, these revisions may also modestly accelerate CDO downgrades in response to deteriorating collateral. It is important to recognise, however, that recent revisions to the agencies' CDO rating models are narrow in scope and are largely backward looking. They are primarily

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<sup>49</sup> For Moody's see *Moody's updates assumptions for Structured Finance CDOs*, Global Credit Research Announcement, 21 September 2007. For S&P see *Revised guidelines on rating new CDOs with certain US RMBS exposure*, Ratings and Methodology, 30 October 2007. For Fitch, see *Global Criteria Change for US Structured Finance CDOs Reflects Heightened Subprime Risks*, Structured Credit Criteria Report, 15 August 2007.

intended to recognise the higher default rates that have already been observed in recent-vintage ABS CDO collateral.

## **C.4 Conclusions**

ABS CDO notes can be expected to perform well in most circumstances, but they are particularly likely to experience severe credit losses during times of system-wide stress when well-diversified collateral pools perform most poorly. This helps to explain why ABS CDOs have performed so differently from more traditional types of fixed income securities with embedded credit risk, such as corporate bonds. Corporate bonds are somewhat more likely to default under systematic stress conditions, but their performance is more sensitive to idiosyncratic factors that affect the creditworthiness of individual issuers. Diversification within CDO collateral pools tends to reduce the effects of idiosyncratic risk factors on the performance of CDO debt notes, particularly those notes with significant credit enhancement. Furthermore, because note losses depend on collateral performance in a nonlinear way, CDO note credit quality can deteriorate rapidly as underlying collateral becomes impaired, leading to large downgrades during stress conditions.

Empirical research shows that risk-averse investors must be paid higher returns to induce them to hold assets with greater exposure to systematic risk. By design, CDO notes have high sensitivity to systematic risk factors relative to corporate bonds, and accordingly, they command higher spreads than similarly rated corporate bonds. Credit ratings, which focus only on contractual payment obligations, are not designed to capture differences in sensitivity to systematic risk.

Even if credit rating agencies could forecast CDO note default probabilities or expected losses with high precision, the pooling of assets and tranching of claims inherent in CDO structures virtually guarantees that CDO ratings will perform differently from corporate debt ratings. That said, shortcomings in the rating agencies' quantitative models may have made them slow to adjust to the effects of deteriorating CDO collateral, which heightened the appearance of a "reversal of fortune" for ABS CDOs once declining collateral quality became widely known.

## Appendix D

### Constant proportion debt obligations: A case study of model risk in ratings assignment<sup>50</sup>

Constant Proportion Debt Obligations (CPDO) have drawn significant attention in the financial press. The first CPDO issue, ABN Amro's Surf, was arranged in the summer of 2006 and closed in November 2006. The Surf notes were rated AAA by Standard & Poor's, yet offered a coupon 200 basis points over LIBOR.<sup>51</sup> The first CPDO default was experienced in late November 2007. The defaulted notes had been rated Aaa by Moody's at issuance in March.

This appendix will explain how a CPDO transaction works, review events in this market to date, and summarise published analyses of rating criteria for CPDOs. This literature has focused on model sensitivities and on vulnerabilities in the first generation CPDO design. Even among the studies written well before the first signs of the current credit crisis, it is found that the high investment-grade ratings assigned to these transactions appeared to depend strongly on model assumptions and the time period used for calibration. Our own analysis suggests that the agency models would have assigned extremely small probabilities (essentially zero) to the conditions realised in the CDS market in 2007.

#### D.1 Mechanics of the first-generation CPDO

The CPDO is a fully funded structured credit product. A special purpose vehicle (SPV) issues floating rate notes and receives par from the investors. The proceeds are held in a cash account as collateral for a long position (ie seller of protection) in the investment grade CDX and iTraxx credit default swap (CDS) indices. The notional size of the long position is a multiple of the size of the cash account, and in this sense is *leveraged*. The maturity of a CPDO is typically ten years.

Leverage is adjusted dynamically over the course of the CPDO lifetime. Each day, the manager of the SPV calculates the *shortfall*, which is the gap between the current net asset value (NAV) of the SPV holdings (ie the sum of the cash account and the mark-to-market value of the CDS index portfolio) and the present value of all future contractual payments, inclusive of management fees. The target leverage is given by a fixed formula as a multiple of the shortfall, and is subject to an upper bound (set at 15 in the first CPDO).<sup>52</sup> Leverage at issuance is typically at the upper bound.

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<sup>50</sup> This appendix was prepared by Michael Gordy. Paul Reverdy provided research assistance. This version 25 February 2008.

<sup>51</sup> The Surf deal won Risk Magazine's "Deal of the Year" (February 2007) and the "Innovation of the Year" at the 2006 IFR Awards, and was featured as one of six "Deals of the Year 2006" in Euromoney, February 2007.

<sup>52</sup> To minimise trading expenses, the SPV trades only if the difference between the target leverage and actual leverage exceeds some minimum threshold.



If the shortfall decreases to zero, the CDS portfolio is unwound and the proceeds held as cash to fund remaining contractual payments. This is referred to as a “cash-in” event. On the other hand, if NAV falls to a predetermined lower threshold (usually 10% of par), the CDS portfolio is unwound and remaining funds are paid out to the noteholders. This “cash-out” event is equivalent to a default, where the recovery rate for the noteholders is (at best) the cash-out threshold level. The CPDO contract may also impose a gap risk test to ensure that NAV can withstand a specified widening of index spreads and a specified level of default losses.<sup>53</sup> If the NAV falls below the gap risk trigger, the SPV must *partially* unwind in order to restore compliance.

The CDS portfolio is kept in the *on-the-run* indices. Every six months, the CDX and iTraxx indices are refreshed. Names that have fallen below investment grade or for which CDS trading is no longer liquid are dropped from the indices and replaced with new names. On the index roll date, the SPV must purchase protection on the off-the-run index and sell protection on the on-the-run index.

Comparison and contrast with earlier forms of structured credit may provide some intuition for the essential characteristics of CPDOs.

- In contrast to CDOs, the “structuring” in a CPDO is on the asset side of the SPV balance sheet (ie through the use of variable leverage) and not the liability side (ie through tranching). All noteholders have the same priority.
- The leveraged super senior CDO note is the closest direct ancestor of the CPDO. The investor in a LSS note sells leveraged protection on a super senior tranche of a CDO. For example, the LSS investor might fund \$6 million on the senior tranche covering the 10% to 100% losses on a reference portfolio of \$100 million (in which case the leverage is  $90/6 = 15$ ). If pool losses exceed a specified threshold, the LSS is unwound and remaining collateral in the SPV is used to replace the senior tranche protection on behalf of the protection buyer. The unwind trigger is based on pool default losses in the simplest cases, or may be based on average spreads on the reference pool CDS or other proxies for mark-to-market losses on the senior tranche.

Important differences between the CPDO and LSS structures include:

- Unlike the CPDO, “structuring” in the LSS note is on the asset side as well as the liability side of the SPV balance sheet.
- Unlike the CPDO, the leverage in the LSS structure is constant over the lifetime of the deal. As a consequence, the LSS note may be highly sensitive to systematic risk in credit spreads when the unwind trigger is based on spread movements.
- The reference pool of the LSS note is fixed (ie it does not refresh to eliminate firms that have fallen below investment grade). Therefore, relative to the CPDO, the LSS note has greater exposure to the risk of defaults in the reference pool, and especially to the systematic component of default risk.
- CPDOs are sometimes described as a variant on credit Constant Proportion Portfolio Insurance (CPPI) deals. As explained in a Fitch report (Linden et al., 2006), Credit CPPI notes are investments whose principal is protected by a low-risk

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<sup>53</sup> A typical test requires that NAV be sufficient to cover a 30% widening in the indices as well as 1.4% default losses (Goulden and Saltuk, 2008).

portfolio consisting of zero-coupon bonds or a cash deposit, and whose return is increased by leveraging the exposure to a risky portfolios of CDS names. At all times, the credit CPPI is structured to ensure that investors' principal will be returned to them at maturity.

- Rather than view CPDO as a variant on CPPI, it would be better to view the CPDO strategy as diametrically opposed to CPPI. When losses are incurred in a CPPI, the SPV must decrease leverage in order to protect the principal. When losses are incurred in a CPDO, the SPV must *increase* leverage in order to make up the increased shortfall in NAV. Return distributions are positive skew (limited downside, unlimited upside) for CPPI and negative skew for CPDO.
- The distinction between CPPI and CPDO is important from a market stability perspective. CPDOs lean against the market, buying back protection when spreads narrow and selling more protection when spreads widen. This tendency to dampen volatility in credit markets stands in contrast to credit CPPI. Portfolio insurance products in the equity markets were believed to have contributed to the 1987 stock market crash, and it stands to reason that credit CPPI could similarly destabilise credit markets. An important caveat, however, is that if spreads spike high enough to breach gap risk triggers or to induce cash-out events, the unwinding of CPDO positions could cause spreads to widen further which in turn could trigger unwinding by other CPDO and so on (see Goulden and Saltuk, 2008).

An obvious flaw in the first-generation CPDO design is its vulnerability to a legal form of front-running. The index roll mechanism forces the CPDO SPV to purchase protection on the off-the-run index and sell protection on the on-the-run index. If CPDOs jointly account for a significant share of the CDS market, the index roll will put downward pressure on on-the-run spreads and upward pressure on off-the-run spreads. As the roll date is known in advance, other market participants can anticipate the spread changes and trade accordingly. At its current size, the CPDO market does not appear to be large enough for front-running to be a problem at present.<sup>54</sup>

From a policy perspective, the issue of front-running is a minor concern. Losses due to front-running are borne by investors in CPDO notes, so these investors have appropriate incentive to demand less vulnerable structures. Proposed modifications include:

- Provide a wider window around the roll date for the manager to trade out of the off-the-run index and into the on-the-run index. Most deals now allow for 10 days to roll the index position.
- Allow the manager to hedge downgraded names in the indices prior to the next index roll.
- Reference bespoke portfolios of CDS, rather than CDS indices. Names would be replaced upon downgrade below a pre-set threshold.<sup>55</sup>

CPDO deals referencing bespoke portfolios appeared by March 2007.

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<sup>54</sup> In private communication, Søren Willemann of Barclays divulged that sources at CreditFlux reported roughly €5.2 billion of CPDOs outstanding as of the index roll on 20 March 2007. Hard information on issuance is scant and perhaps unreliable. For example, Jobst et al. (2007) report under USD 2 billion of issuance by March 2007. As of February 2008, the total notional of CPDOs rated by Moody's was roughly € 2.6 billion.

<sup>55</sup> There is an important trade-off here: a higher rating threshold reduces default risk, but also reduces the opportunity to profit from mean-reversion.

Relative to the first Surf issue, subsequent index CPDO issues have typically chosen a more conservative risk/return profile. Coupons on CPDO notes and arranger fees have both fallen roughly by half in order to reduce the need for high leverage. Maximum leverage has sometimes been reduced, say to 10.

## D.2 Rationale

The CPDO structure takes advantage of several empirical regularities in investment grade credit markets. First, investment grade credit spreads appear to embed a higher risk premium. Put another way, the empirical default frequency of investment grade credits explains only a small fraction of the observed risk-neutral default probability embedded in market prices (eg Elton et al., 2001). An investment grade CDS portfolio can be leveraged to achieve high returns with relatively modest risk.

Second, investment grade default intensities appear to be strongly mean-reverting in time-series (Huang and Zhou, 2007). Consequently, CDS spreads on investment grade names tend to mean-revert. This underpins the CPDO's "double or nothing" strategy. If spreads balloon and the SPV loses value, the CPDO increases leverage. Mean-reversion implies that future spread movements are more likely to be negative than positive, and so more likely to earn gains than losses. Similarly, by decreasing leverage when spreads tighten, the CPDO avoids losses in the likely event that spreads subsequently increase.

Third, the term-structure of credit spreads is typically upward-sloping for investment grade issuers. If the index composition is unchanged, the SPV realises a mark-to-market gain on the biannual index roll when it buys protection on the 4.5 year off-the-run index and sells protection on the new five year on-the-run index. If the index composition changes due to credit deterioration among some names in the off-the-run index, the roll-down benefit will be reduced or possibly negative. For a CPDO referencing both CDX and iTraxx in equal portion, the roll-down benefit would have been positive for every roll date observed so far (since September 2004).

These arguments lend plausibility to the CPDO as a *trading strategy*. Many hedge funds are active in the CDS markets, and it would not be surprising if some of these institutions were pursuing a strategy along these lines. What is less obvious is the rationale for structuring CPDO liabilities as debt rather than as equity. The sensitivity of the CPDO strategy to market volatility makes the structure inherently fragile when backed by debt. Market commentary suggests that the demand for this debt is driven by some of the same factors that drive demand for CDOs. In particular, there are pension funds and other institutions that are restricted by law or by mandate to invest primarily in investment grade debt. In the environment of tight credit spreads that prevailed until June 2007, the ability to offer 200 basis points on a AAA-rated security made for easy marketing.

Accounting treatment may also play a role. CPDO debt is marketed to buy-and-hold investors who report on an accrual basis. For these investors, high mark-to-market volatility of the SPV's NAV can be ignored so long as cashflows are stable. The CPDO structure takes on little default risk (due to the biannual refreshing of the names in the CDS indices), and spread risk by itself is perceived as unlikely to cause losses large enough to disrupt contractual payments to noteholders. The caveat here is that high variance in the SPV's NAV ought to imply high ratings volatility, which is a problem for many buy-and-hold investors. It is not clear whether this was well-understood by investors until the recent credit crisis.

Relative to most other structured credit products, CPDOs offer transparency in pricing. As we discuss below, modelling the future performance of a CPDO is far from straightforward.

Pricing, however, is almost trivial. The investors in CPDO notes hold pro-rata shares in the NAV of the SPV less the present discounted value of the management fees. The SPV is invested exclusively in liquid CDS positions and in cash, and so the NAV is easily calculated on a daily basis. A corollary of the CPDO accounting identity (ie that the value of liabilities must equal the NAV) is that the value of the CPDO notes at origination is below par and almost independent of the contractual coupon.<sup>56</sup>

### D.3 Risk characteristics and performance history

Due to the path dependence of the NAV and the sensitivity of the leverage rule to remaining maturity, it is not easy to characterise in a simple manner the set of scenarios that would trigger cash-out or failure to return par at maturity. Isla et al. (2007) distil a large set of analyses into the following rules of thumb:

- The lower the volatility in CDS spreads and the higher the rate of mean-reversion in spreads, the less likely is the CPDO to default on contractual payments.
- The lower the coupon on the CPDO notes and the lower the arranger fees, the lower the required leverage, and so the lower the likelihood of default.
- Spread-widening is generally bad news for the CPDO notes, but not necessarily. If spreads widen early in the life of the CPDO and then hold steady, the higher carry on future index positions can outweigh the initial loss of NAV. Furthermore, if spreads subsequently mean-revert, there will be a gain in NAV. However, if spreads widen late in the life of the CPDO, there is less time to make up loss before maturity. In this case, the CPDO is more likely to fail to repay full principal at maturity.
- A severe spike in spreads can trigger a cash-out event. One example in the Isla et al. (2007) analysis is based on a scenario in which a steady increase in spreads from 25bp at inception to 75bp after 4.75 years is followed by a sudden spike to 300bp.
- Default events generate large losses to NAV, and in this respect the CPDO behaves similarly to a thick equity tranche of a CDO. The index roll limits but does not eliminate the CPDO's exposure to defaults. In the downturn of 2001-02, Enron and WorldCom went from investment grade to default within six months (Linden et al., 2007).

The CPDO structure is regarded as less vulnerable to systematic credit risk than other structured credit products of similar rating. The CPDO avoids the liability structuring that makes senior CDOs highly sensitive to correlation among the reference names, and the dynamic leverage mechanism makes the CPDO robust to systematic widening of spreads (except in extreme scenarios). However, published analyses have devoted little or no attention to sensitivity to a focused *sectoral* credit problem. If downgrades within a major sector cause several names in the index to be dropped at the next roll date, the loss in NAV could be material. If spreads are unchanged on names outside the affected sector, the CPDO structure will not receive the benefit of higher carry to compensate. This apparent gap in the analyses is surprising because it was a focused sectoral event that caused large

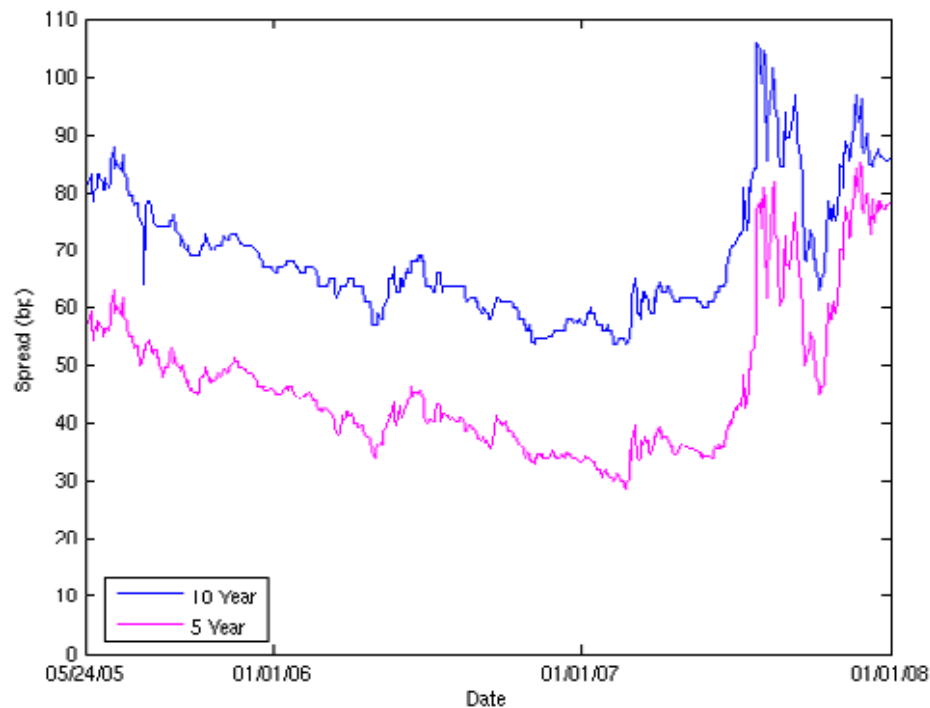
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<sup>56</sup> The contractual coupon affects the probability of a cash-out event, and so affects the PDV of the management fees.

losses for some CDO investors in the spring of 2005.<sup>57</sup> Even more obviously, the greater volatility of a single-sector portfolio increases the vulnerability of any industry-specific CPDO. The large losses recently experienced by the financial-only CPDOs bear witness to this point.

The recent rise in North American investment grade CDS spreads offers an opportunity to examine index CDPO performance under stress. The great bulk of CPDO issuance took place in the fall of 2006 and spring of 2007, when the five year North American investment grade index (CDX.NA.IG 5Y) was trading in the 30–35 basis points range. As shown in Figure D.1, this index spiked to 81 basis points in early August, fell to 45 basis points in early October, and reached 85 basis points in late November. The recent volatility is in marked contrast to the long period of slowly-varying spreads that had prevailed since early 2006. A similar pattern is seen in the European iTraxx Main indexes in Figure D.2.

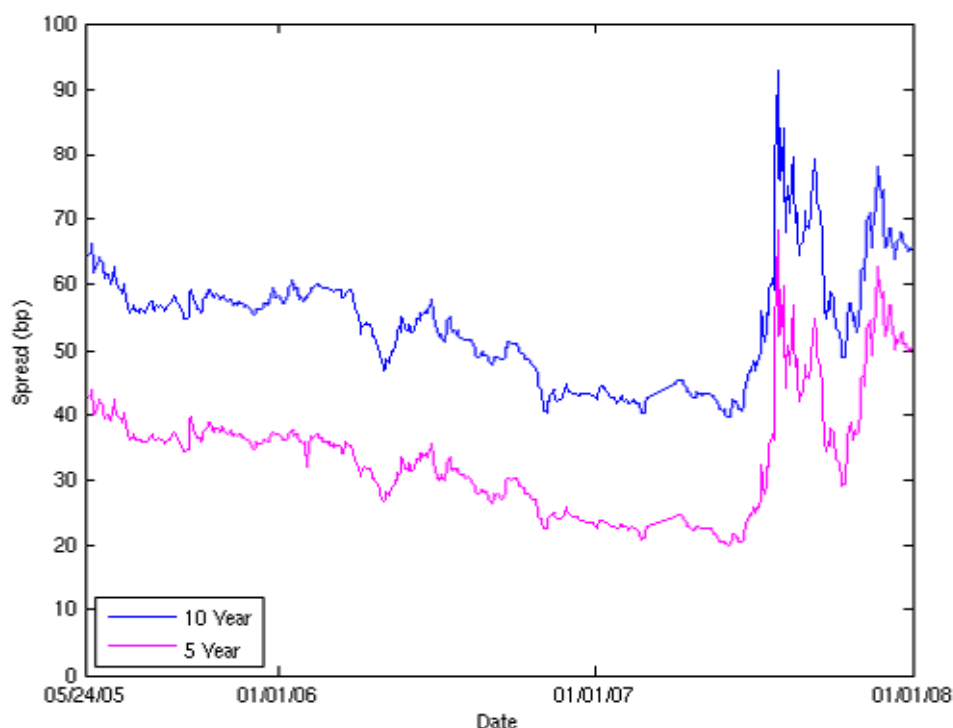
Figure D.1  
**CDX North America IG Spreads**



Source: MarkIt

<sup>57</sup> Some hedge funds at the time were buying equity tranches of CDOs and shorting mezzanine tranches as a hedge. When Ford and GM were downgraded, equity tranches took a loss. As other sectors remained healthy, the mezzanine tranche prices did not move in the same direction, so the hedge proved ineffective.

Figure D.2  
iTraxx European IG Spreads



Source: MarkIt

The volatility of the CDX market induced high volatility for the NAV of CPDOs. The blue line in Figure D.3 plots the NAV for a hypothetical index CPDO issued in March 2007. The NAV fell to the 70–75 range upon the initial spike in spreads in July/August, gradually recovered ground as spreads fell through early October, and then fell again to 70–75 by the end of November. Spreads have widened significantly since the beginning of 2008 to 153 bp and 116 bp for the five-year CDX.NA.IG and iTraxx Main respectively. For some index CPDOs, NAV may be as low as 40 as of mid-February. While these mark-to-market losses are quite substantial, index CPDO notes do not appear to be in immediate danger of cash-out and have retained (at least for now) their investment-grade status.<sup>58</sup>

The recent episode also demonstrates the vulnerability of a CPDO with a more concentrated pool. As widely reported in the financial press, a financial-only CPDO deal arranged by UBS in March 2007 hit its cash-out trigger on November 21. This is the first default by a CPDO and an embarrassment for Moody's, which had rated the CPDO notes Aaa at inception. The black line in Figure D.3 plots the NAV for a hypothetical financial-only CPDO issued in March 2007. Like the UBS deal, this CPDO invests in a 10x leveraged bespoke portfolio of 10 year CDS on 50 financial firms. Despite the lower leverage, the lack of diversification left the

<sup>58</sup> On 15 February 2008, Moody's downgraded 16 index CPDOs, including several Surf issues, to as low as A2. All are on review for possible further downgrade. For an assessment of the likelihood of near-term breach of gap risk triggers, see Goulden and Saltuk (2008). Leeming et al. (2007) estimate that the five-year iTraxx Main must reach 140bp to trigger a cash-out event on index CPDOs.

structure vulnerable to a sectoral downturn.<sup>59</sup> The referenced names included Radian, MBIA and Washington Mutual, some of which have experienced six-fold increases in 10 year CDS spreads. This hypothetical CPDO hit its cash-out trigger at close to the same time as did the UBS deal, and it is believed that other financial-only CPDOs of this vintage should be vulnerable as well (Leeming et al., 2007).

Figure D.3  
**Fall in NAV with widening spreads**



CPDOs launched on 20 March 2007. Assumes coupon consistent with AAA rating and no arranger fees. The Index CPDO references a 15x leveraged portfolio of 5 year iTraxx Main and CDX.NA.IG indexes. The Financial CPDO references a 10x leveraged bespoke portfolio of 50 senior financial 10 year CDS.

Source: Leeming et al. (2007).

## D.4 Model risk in CPDO ratings

The AAA rating assigned to the first CPDOs generated significant controversy in the financial press. Rating agencies that did not participate in the first issues published reports strongly critical of the AAA rating. Jobst et al. (2007) of DBRS find that variations in model specification, and in data source and sample period for calibration, can lead to dramatic changes in estimated rating. They demonstrate particular sensitivity to assumptions governing roll-down benefits and to assumptions on CDS market liquidity (ie bid-ask spreads). They acknowledge that one can justify the AAA rating on the basis of reasonable models calibrated to available data, but suggest that a BBB rating would be equally justifiable. Linden et al. (2007) of Fitch conduct similar exercises and obtain similar results. They put special emphasis on stress tests showing that the CPDO structure is less robust to extreme events than AA and AAA rated CDO tranches. They conclude, and state in blunt terms, that the first-generation CPDO notes do not achieve a rating of AA, much less AAA.

The distress experienced in credit markets in the second half of 2007 provides an opportunity to evaluate ex-post the modelling assumptions that underpinned the rating of CPDOs. As we

<sup>59</sup> As bespoke deals, the financial-only CPDOs have no roll feature, so also are structurally more sensitive to spread widening.

have the benefit of hindsight, our proper purpose is not to criticise rating opinions assigned ex-ante, but merely to demonstrate how a model that may look reasonable at first glance can dramatically understate the risk of a complex structure such as a CPDO.

The Moody's CPDO model is built on the CDOROM engine that underpins most or all of Moody's structured credit analysis. CDOROM models correlated defaults and rating migrations over time for a portfolio of obligors. It is similar in spirit to a multi-period version of the popular CreditMetrics model of portfolio credit risk. Unlike a CDO, the performance of a CPDO depends on spread changes (and not solely on obligor default times), so the CDOROM model is augmented with a model of stochastic ratings-based constant-maturity spreads. For a CPDO referencing, say, a five-year CDS portfolio, the model generates random paths for the five-year AAA spread, five-year AA spread, and so on. It is assumed that when an obligor changes rating grade, its CDS spread jumps to the level associated with its new grade. The spreads are assumed to evolve over time as modified "constant elasticity of variance" (CEV) processes. More precisely, the spread  $S_k(t)$  for grade  $k$  follows the stochastic differential equation

$$dS_k(t) = \kappa_k (\theta_k - S_k(t)) dt + \min(\bar{\nu}_k, \eta_k + \sigma_k S_k(t)^{\gamma_k}) dW_k(t),$$

where  $\theta_k$  is the long-run mean spread for the grade,  $\kappa_k$  controls the rate of mean-reversion,  $\bar{\nu}_k$  is the cap on volatility,  $\eta_k$  and  $\sigma_k$  are volatility parameters and  $\gamma_k$  is the CEV exponent.  $W_k(t)$  is a Brownian motion, and the correlation of increments  $dW_k(t)$  and  $dW_j(t)$  for grades  $(k, j)$  is  $\rho_{kj}$ .

Does the model allow for market spread widening of the magnitude observed in 2007? We have privately obtained from Moody's the baseline parameter values for the five-year spread processes. Under these baseline values, we can assess the likelihood that a one-year scenario randomly drawn at the start of 2007 would share various properties of the realised spread paths. In Figure D.4, we plot the paths for the five-year spreads for the four investment grades (Aaa, Aa, A and Baa) in 2007.<sup>60</sup> First, we see that the spreads peaked together. On two dates near the end of the year, we observe that the AAA, AA, A and BBB spreads exceeded 60, 100, 125 and 160 basis points, respectively. We formalise this as a test condition

$$(T1) \quad \exists t \text{ for which } S_{Aaa}(t) > 0.0060 \wedge S_{Aa}(t) > 0.0100 \wedge \\ S_A(t) > 0.0125 \wedge S_{Baa}(t) > 0.0160$$

That is, the test T1 is satisfied for a scenario if there exists some date  $t$  on which all four investment grade spreads surpass the given threshold values.

Second, we observe that the average spread levels for the last quarter of the year were 37.0, 76.8, 88.1 and 117.3 basis points for the four investment grades. Let  $\bar{S}_k(t_1, t_2)$  denote the average spread for grade  $k$  over the period  $(t_1, t_2)$ . Our second test condition is

$$(T2) \quad \bar{S}_{Aaa}(3/4, 1) > 0.0035 \wedge \bar{S}_{Aa}(3/4, 1) > 0.0075 \wedge \\ \bar{S}_A(3/4, 1) > 0.0085 \wedge \bar{S}_{Baa}(3/4, 1) > 0.0115$$

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<sup>60</sup> We use bond market spreads over LIBOR as a proxy for CDS spreads.



That is, the test T2 is satisfied if the average spreads over the final quarter of the scenario exceeds a threshold for each of the four investment grades.

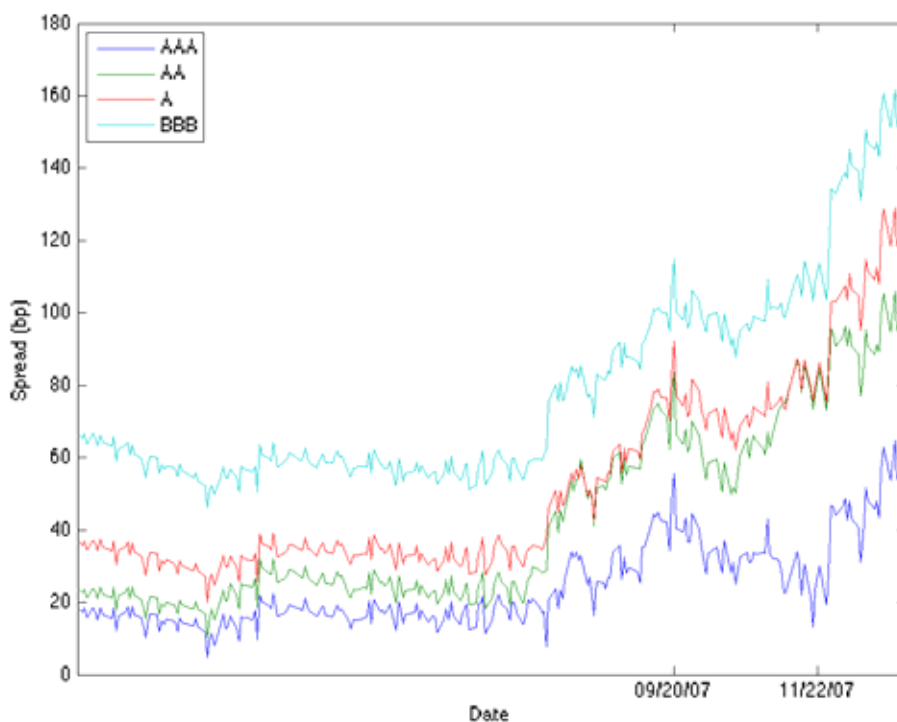
Last, we observe that the average spread levels for the last six months of the year were 32.6, 62.7, 71.2 and 98.7 basis points, respectively. Our third test condition is

$$(T3) \quad \bar{S}_{Aaa}(1/2, 1) > 0.0032 \wedge \bar{S}_{Aa}(1/2, 1) > 0.0060 \wedge \bar{S}_A(1/2, 1) > 0.0070 \wedge \bar{S}_{Baa}(1/2, 1) > 0.0098$$

That is, the test T3 is satisfied if the average spreads over the second half of the one-year scenario exceeds a threshold for each of the four investment grades.

We ran 250,000 scenarios under the baseline parameter assumptions and using the prevailing spreads at the start of 2007 as the initial  $S(0)$ , and found that none of the three tests was satisfied for even a *single* scenario. Based on these results, we would conclude that the spread paths of 2007 were all but impossible. Were the observed spreads in 2007 really very unusual? In Figure D.5, we plot the paths for the five-year spreads for the four investment grades over 2000–07. If the calibration period had given most weight to the period 2004–06, then estimated long-run means ( $\theta$ ) would be low. Perhaps more importantly, volatility was subdued over this period. If we look further back to 2001–03, however, the current level and volatility of spreads do not at all appear unprecedented.

Figure D.4  
Investment grade spreads, 2007

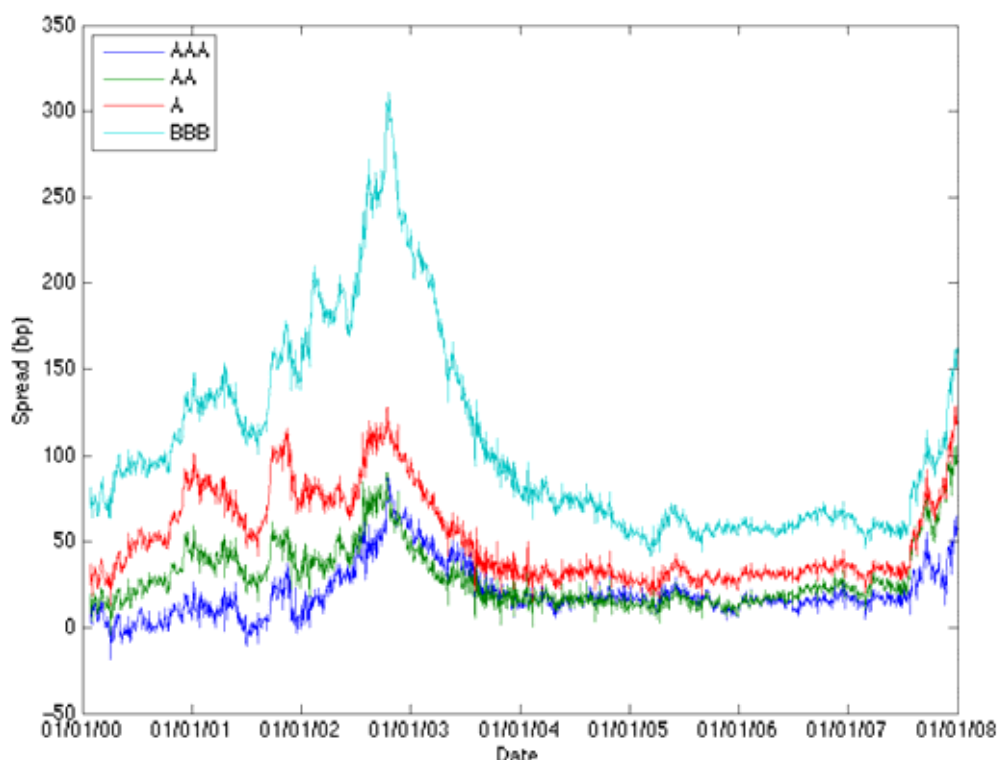


Source: Ratings-based bond spreads constructed from Merrill Lynch database.

The rating agencies do perform sensitivity analysis on their results using stressed parameter values. In the context of our analysis of the Moody's model, it appears that the stress case would need to have been extreme (from the baseline perspective) to have made much

difference in our three tests. To generate high spreads for all four rating grades, one needs higher long-run means, higher volatility, and higher correlation across grades. We ran a simulation in which  $\theta$  values were doubled over baseline, volatility caps ( $\bar{v}$ ) were removed, and correlations  $\rho$  increased (dramatically) to 70%. For these severely stressed parameter values, test T1 was satisfied in 0.11% of scenarios, test T2 in 0.65%, and test T3 in 2.75%. The three tests were satisfied jointly in only 0.08% of scenarios. Moody's has recently disclosed that it "will be updating its analytical approach to take into account the current high spread volatility environment," which suggests a recognition that current market conditions are inconsistent with its model under baseline parameter values.<sup>61</sup>

Figure D.5  
Investment grade spreads, 2000–07



Source: Ratings-based bond spreads constructed from Merrill Lynch database.

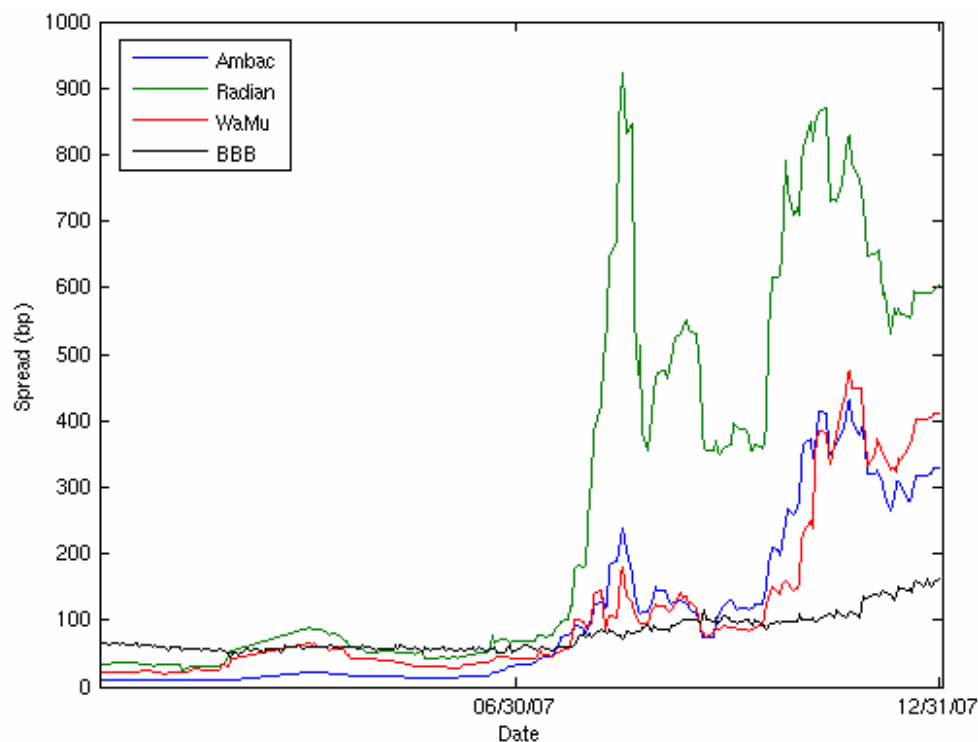
From the perspective of Moody's models, another anomaly of 2007 is the sectoral variation in ratings-based spreads. Sectoral concentration in the Moody's model is addressed via the ratings migration correlation structure of the CDOROM module. That is, there may be sectoral risk in ratings migration but, conditional on the realised ratings of the obligors, there is no sectoral or idiosyncratic risk in spread movements. For financial obligors in 2007, this stylised characterisation of risk proved inadequate. Among ten identifiable obligors included in the failed UBS financial-only CPDO, none suffered any whole-letter downgrade up to the unwind date, and all remained A-rated or better.<sup>62</sup> However, the market assessment of these

<sup>61</sup> See "Moody's downgrades 16 corporate CPDOs," Moody's Investors Service, Global Credit Research Rating Action, 15 February 2008.

<sup>62</sup> Washington Mutual Bank was downgraded from A1 to A2, and Washington Mutual Finance Corp from Aa1 to Aa2. Some other names within this group of ten were placed on watch for possible downgrade.

obligors differed sharply from that of the rating agencies. Figure D.6 depicts how the CDS spreads on three names widened dramatically over the course of 2007. By year-end, their CDS spreads were several times those of BBB bond spreads.

Figure D.6  
**Spreads for select financial names in 2007**



Source: CDS spread data from MarkIt. Bond spreads constructed from Merrill Lynch database.

We have focused on Moody's methodology only because we were granted sufficiently detailed information on calibration. The S&P model (Wong and Chandler, 2007) differs in important respects, but we see no reason to expect that this model would have fared better in our ex-post evaluation. The S&P model allows for correlated default events, but not correlated rating migrations, and the index spread is modelled directly (ie not as a composite of the spreads on the underlying CDS). Therefore, sectoral shocks would be even more difficult to incorporate in such a framework.

## D.5 Aftermath

The structured credit market is said to be experiencing a flight to simplicity. As discussed in the main text of this report, it appears that issuance of CDO of ABS, leveraged super senior notes, and other nested structures has dried up, and many market participants believe that the most complex products may never appear again. Perhaps surprisingly, this does not imply that CPDOs will necessarily vanish. The flight to simplicity should more precisely be understood as a flight to *pricing transparency*. Model prices for CDO of ABS are highly

sensitive to assumptions on dependence across assets in the collateral pool. The CPDO may be difficult to model for ratings and risk-management purposes, but its pricing is entirely transparent. ABN Amro, for example, has quoted prices on its own CPDOs throughout the recent period, and in November revealed plans to issue USD 230 million in new CPDOs.<sup>63</sup>

Less obvious is whether the CPDO market can withstand a more conservative rating regime. Even before the recent troubles, market analysts appeared to expect that future CPDOs would be rated more conservatively. If coupons must be dramatically reduced in order to maintain investment grade rating, demand for CPDO notes will naturally dwindle. The CPDO is implicitly an arbitrage, as it merely repackages existing instruments in a form that can garner an investment grade rating. If CPDO notes cannot offer a substantial premium over comparably-rated debt, the costs of the arbitrage (ie the management fees) cannot be covered.

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<sup>63</sup> Steve Lobb of ABN Amro claims that the bank has bought CPDO notes from investors at its quoted prices, and also has sold CPDO notes in the secondary market. See “CPDO market alive, kicking as ABN brings new deals,” Reuters, 12 November 2007. Market sources report that no new rated CPDOs have been sold since the summer of 2007, which casts doubt on whether ABN Amro's plans for new issuance came to fruition.

## **Appendix E**

### **The recommendations from the 2005 Report**

Appendix E is taken from pp. 5-10 of the 2005 report.

The Working Group has developed recommendations in relation to risk management practices, disclosure, and supervisory approaches. The individual recommendations are included in the main text of the report at the end of the relevant sub-section and thus their ordering largely reflects the order in which the relevant topics are discussed in the main text of the report. Some of the recommendations have several parts, consistent with the nature of the issue being discussed. There are a few issues that cut across several of the recommendations. In particular, the role of external ratings as applied to CDO transactions is relevant to recommendations concerning risk management practices as well as disclosure practices.

#### **Recommendation 1: Role of Senior Management**

Market participants should use CRT instruments in a manner consistent with the overall risk management framework approved by their board of directors or equivalent senior management body, and implemented by their senior management. Before entering the CRT market, policies and responsibilities governing CRT instruments use should be clearly defined, including the purposes for which these transactions are to be undertaken. These policies should be reviewed as business and market circumstances change, for example as the firm enters into increasingly complex transactions. Senior management should approve procedures and controls to implement these policies and management at all levels should enforce them. Senior management should have access to appropriate management information systems covering the extent of CRT transactions undertaken by the firm.

#### **Recommendation 2: Credit Risk**

Market participants transacting in CRT instruments should have the capacity to understand and assess the credit-related risks inherent in these instruments. This should include the capacity to understand the major variables on which the valuation of the instrument depends and how the valuation of the instrument will be affected by changes in these variables. Firms that undertake CRT transactions on both the asset and the liability side of the balance sheet should have the ability to assess on a comparable basis the relevant credit risk regardless of how the transaction appears on the balance sheet.

Aggregation of credit risk: Market participants should seek to ensure that their measures of credit exposures to individual obligors are as comprehensive as possible, for example by including both direct exposures (eg loans and OTC derivatives exposures) as well as indirect exposures from CRT transactions.

### **Recommendation 3: Credit Model Risk**

Firms that rely on models to assess the valuation and risks of CRT instruments should have sufficient staff and expertise to properly understand the assumptions and the limitations of those models, and to manage their usage appropriately. It is essential that the usage of such models be subject to periodic validation independent of the trading or business area, including independent audits conducted by capable internal or external auditors. Firms should undertake efforts to regularly compare model-based valuations with available market proxies and/or valuations of similar instruments produced by other firms. Management and risk monitoring staff should take into account the assumptions and the limitations of those models in making decisions in relation to CRT instruments.

**Correlations:** Firms should thoroughly understand the sources for and roles of correlation assumptions in models used for valuation and risk management of CRT instruments. Firms should regularly assess the impact of changes in correlation assumptions on model outputs, for example via stress testing.

**Extent of risk capture:** Firms should assess the extent to which trading/hedging approaches in CRT instruments may leave the firm exposed to risks that are not routinely captured in the firm's risk management calculations (eg "jump to default" or other issuer-specific risks and basis risks). In particular, firms should have the capacity to monitor the extent of potential build-up in such risks and be able to incorporate the results of such monitoring into their risk management approach. Firms should regularly evaluate the need to incorporate such risks into their routine risk measurement calculations.

### **Recommendation 4: External Ratings**

Market participants should understand the nature and scope of external ratings assigned to CRT instruments, particularly CDOs, how these differ from external ratings assigned to other types of instruments, as well as how ratings methodologies differ across the rating agencies. In particular, market participants should seek to understand the extent to which the external ratings are conveying information on probability of default or expected loss as opposed to information on the potential for loss in unexpected circumstances.

**Supplementary measures:** Market participants should encourage the rating agencies to continue their efforts to provide information that supplements the ratings themselves. Efforts to provide information on the events and scenarios that would lead to CDO ratings downgrades or information on ratings volatility are examples of additional information that could help market participants better understand the risks of CDO instruments.

### **Recommendation 5: Dynamic Management of Structured Transactions**

Market participants investing in dynamic structures should evaluate carefully the record of the manager, the nature of the manager's discretion, and the potential for conflicts of interest. Key issues in this regard include triggers that call for or prevent certain actions, provisions governing the diversion of cash flows to various tranches, and the ability/right to substitute reference credits.

## **Recommendation 6: Counterparty Credit Risk**

Counterparty credit risk arising from unfunded CRT transactions should be managed actively, at least to the same standards applied to other OTC derivatives. In particular, for risk management purposes, counterparty credit exposures on derivatives, and all other credit exposures to the same counterparty, should be aggregated taking into consideration legally enforceable netting arrangements. Counterparty credit exposures should be calculated frequently (in most cases, daily) and compared to credit limits. All counterparties, regardless of collateral status, should be subjected to a sound due diligence process. Buyers of credit protection should evaluate the potential correlation of reference entities and protection sellers and take account of such assessments within their risk management processes.

## **Recommendation 7: Legal Documentation Risk**

All market participants need to pay careful attention to the legal documentation relating to CRT instruments, such as the range of credit events covered by the instruments and to the clear and unambiguous identification of underlying reference entities. In particular, credit hedging firms should specifically assess whether the reference entity in the underlying contract is the one to which they have credit exposure. A clear understanding of documentation is of particular importance for complex, structured CRT products.

Standardisation: To reduce legal risk arising from CRT transactions, market participants should aggressively continue their efforts towards standardisation of documentation, including for CDOs and other more complex products.

## **Recommendation 8: Legal Risk and Appropriateness of Transactions**

Before entering into a CRT transaction, market participants should undertake the due diligence necessary to clearly identify their legal responsibilities to the counterparty or customer, based on their role in the particular transaction, and to determine that their counterparty or customer has the legal authority to enter into the transaction. Furthermore, originators, dealers and end-users should have in place processes to assess and control potential reputational risks involved in the transaction.

Marketing: When marketing structured CRT products, originators and dealers should seek to foster a complete understanding of the nature and material terms, conditions, and risks involved and should not encourage exclusive reliance on external ratings as a measure of risk associated with the transaction. Originators and dealers should have in place processes for reviewing marketing materials to ensure that such materials present all relevant information fairly and accurately.

Investor Information: Before entering into a CRT transaction, investors should ensure their ability to obtain, both at the outset and on an ongoing basis, the necessary information to properly evaluate and manage the risks associated with their investment. In particular, they should take into account their ability to access information on the valuation and risk profile of the investment.

## **Recommendation 9: Use of Material Non-Public Information**

Market participants, especially banks that lend to firms referenced by CRT instruments, should take care to ensure compliance with all relevant laws and regulations as well as industry recommendations concerning the use of material non-public information (MNPI) as it relates to their participation in CRT transactions. Efforts by banks to ensure a comprehensive approach to compliance with such restrictions can take a number of forms. In each case, however, banks and other market participants with access to MNPI should adopt, and be able to clearly demonstrate that they have adopted, policies and procedures sufficient to address the concern. Supervisors, especially bank supervisors, should review the adequacy of and compliance with such policies and procedures, taking corrective action where necessary.

## **Recommendation 10: Documentation and Settlement Risk**

Market participants should execute confirmations and any other documentation associated with a CRT transaction promptly after the transaction has been agreed. Market participants should establish clear standards or guidelines for the time periods that should be permitted for the exchange of documents and confirmations. Supervisors should reinforce that significant backlogs of unsigned documentation are unsound by requiring market participants that are unable or unwilling to effectively manage their volume of transactions to adopt corrective measures.

Assignments: While the assignment of CDS transactions has the potential to reduce the ongoing operational risks associated with maintaining large two-way books, market participants should ensure that such assignment occurs in a manner consistent with the underlying documentation and with sound risk management practices.

## **Recommendation 11: Operational Risk**

Market participants should ensure that their CRT activities are undertaken by professionals in sufficient number and with the appropriate experience, skill levels, and degrees of specialisation. Reports to senior management on the performance of areas conducting such activities should seek to encompass these issues as well as measures of financial performance. In addition, before committing to this market, market participants should make sure that their information and technology systems are commensurate with the nature and level of their market activity.

## **Recommendation 12: Market Liquidity Risk**

Market participants should understand the liquidity characteristics associated with the CRT positions they have taken on, including those positions used for hedging purposes. In particular, investors in CDOs and other structured products should be aware of the limitations on secondary market activity associated with such instruments. Firms should periodically consider how their positions in CRT instruments would behave under stressed liquidity conditions and incorporate the results of such assessments into their risk management approach.



## **Recommendation 13: Disclosure**

Market participants should continue to work to improve the quality of material public disclosures concerning CRT transactions and the resulting distribution of credit risks.

While disclosures of CRT-related risks need to respect the frameworks within which individual firms present their risk profiles, there is room for improvement in a number of areas. Clearly, the need for improvements varies across firms and the relevance of these recommendations will also vary with the level of CRT activity undertaken by firms. In certain cases (eg asset managers), the recommendations may be appropriately targeted at internal reports to boards of directors or trustees.

- Market participants should provide clear qualitative descriptions of the nature of their activities, including a discussion of the purpose and nature of CRT transactions employed.
- Market participants, such as banks, that typically provide summary information and breakdowns (eg by credit quality, industry or geography) of credit exposures for lending portfolios, should consider presenting information that describes how CRT transactions affect these summary measures and breakdowns of credit exposure.
- Market participants that engage in CRT transactions as part of their trading activities should consider providing breakdowns of trading risk exposure and revenue that detail credit-related risks separately from other risk categories such as interest-rate risks (eg disclose credit-related VaR separately).
- Market participants that report asset holdings by ratings categories should not simply aggregate holdings of CDOs with holdings of other types of instruments that are similarly-rated. Because of the differences in risk characteristics, it would be more appropriate to consider distinguishing material holdings by type of instrument (eg bond vs. CDO) and/or to consider structuring reporting categories by spread amounts.
- Market participants, such as insurers, that take on credit exposures as an underwriter, should consider providing information on the amount of such exposures and associated provisions.

## **Recommendation 14: Aggregate information**

The efforts of the Committee on the Global Financial System to develop mechanisms that better identify aggregate information on credit risk should be strongly supported by supervisory authorities and market participants.

## **Recommendation 15: Supervisory Efforts**

Supervisory authorities should undertake the steps necessary to enhance their understanding of evolving market developments in relation to CRT transactions. This includes the need to attract and retain qualified staff and to implement procedures, such as training programs, to improve staff knowledge and understanding on an ongoing basis. Supervisors would benefit from periodic discussions with market participants regarding developments in this area.

## **Recommendation 16: Supervisory and Regulatory Review**

Supervisory authorities should periodically review regulations, supervisory guidance and reporting mechanisms that are pertinent to CRT transactions. In many cases, supervisory guidance and regulations applicable to OTC derivatives are not tailored specifically to credit derivatives transactions. While in many cases this is appropriate, there may be circumstances where the regulations, supervisory guidance or reporting mechanisms need to be adapted to some extent to better fulfil their specific objectives. Supervisors should undertake efforts to understand thoroughly the accounting treatment of CRT transactions and their implications, while also seeking to provide knowledgeable input into the development of appropriate accounting standards for CRT transactions.

## **Recommendation 17: Supervisory Information Sharing**

Supervisory authorities should continue efforts to share information on CRT activities with the objectives of strengthening their mutual understanding of developments, promoting further improvements in risk management practices by market participants, and enhancing supervisory and regulatory approaches. In particular, supervisory authorities should share information on the regulatory approaches adopted in such areas as minimum capital and securitisation to better understand the potential interactions between the different approaches and the incentives that these interactions could create for market participants.

## Appendix F

### List of members of the Working Group on Risk Assessment and Capital

Co-Chairs	<b>Lance Auer</b> <b>Tom Crossland</b>	<b>Federal Reserve Bank of New York</b> <b>Financial Services Authority</b>
Belgium	Jeroen Lamoot	Banking, Finance and Insurance Commission
Canada	Daniel Mayost	OSFI
France	Emmanuel Dupouy Sylvain Cuenot	ACAM Commission Bancaire
Germany	Christoph Schlecht Michael Porth	BAFin BAFin
Italy	Mario Quagliariello	Bank of Italy
Japan	Takashi Isogai	Bank of Japan
Netherlands	Klaas Knot	Netherlands Bank
Spain	Marta Estavillo José Manuel Portero	Bank of Spain Comisión Nacional de Mercado de Valores
Switzerland	Christopher McHale	Swiss Federal Banking Commission
United Kingdom	Douglas Hull	Financial Services Authority
United States	Michael Gibson Mary Frances Monroe Anna Lee Hewko Tim Clark Robert Scavotto Marc Steckel Randall Roy Alexandria Luk Ray Spudeck Kurt Wilhelm	Board of Governors Board of Governors Board of Governors Federal Reserve Bank of New York Office of the Comptroller of the Currency Federal Deposit Insurance Corporation Securities and Exchange Commission Office of Thrift Supervision National Association of Insurance Commissioners Office of the Comptroller of the Currency
EU	Peter Smith	European Commission
FSF	Patricia Baudino	Financial Stability Forum
IMF	Todd Groome	International Monetary Fund
Secretariat	Brad Shinn	Joint Forum Secretariat