Reports

Introduction

Reports address specific issues of relevance to the financial system (whether institutions, markets, or clearing and settlement systems) in greater depth.

Risk appetite is one factor that determines the demand for risky assets, and this demand can have implications for the allocation of capital to productive uses. Large changes in risk appetite may also have undesirable consequences for financial stability. Credit booms and increased investment in risky assets resulting from high investor appetite for risk could ultimately lead to an increase in non-performing assets held by all investors, including financial institutions. In *A Brief Survey of Risk-Appetite Indexes*, the authors provide an overview of various published indexes for measuring risk appetite and assess the signals that they provide about changes in risk appetite. The survey focuses on the possible application of the information contained in these indexes to the monitoring of financial stability.

A significant feature in the evolution of credit markets around the world has been the development of instruments to transfer credit risk. One of these is the credit default swap (CDS). A CDS can be thought of as insurance against default on a loan or bond. CDSs can potentially add to the completeness of corporate debt markets and increase the efficiency of financial systems. CDSs can also contribute to financial stability by facilitating the ability of investors to hedge credit risk and gain diversification, as well as by allowing credit risk to be held by those most willing to bear it. In *Credit Default Swaps and the Canadian Context*, the author describes the basic mechanics of a CDS, assesses the potential impact of CDSs on market efficiency, and considers the implications of the growing CDS market for financial stability. The current state of the CDS market in Canada is also assessed, together with its future outlook, including the increasing participation of major Canadian banks and the larger Canadian pension funds.

A key financial instrument to emerge from the field of structured finance is the collateralized debt obligation (CDO). These instruments can be defined as the pooling of assets, the tranching of liabilities that are backed by the asset pool, and the delinking of the credit risk of the collateral asset pool from the credit risk of the CDO originator. In the current environment of low returns on investments, CDOs are increasingly attracting the interest of institutional investors because of their superior yields relative to conventional fixed-income instruments. Globally, the growth in the CDO market has been explosive, and major Canadian banks have been actively involved in the creation and distribution of these products through their global investment banking arms. The report *Understanding the Benefits and Risks of Synthetic Collateralized Debt Obligations* highlights the positive contribution of CDOs to the efficiency of the financial system, but also points out that these instruments raise potential risks, in particular, those related to the complex models used by rating agencies to assign ratings to these structures.

A Brief Survey of Risk-Appetite Indexes

*Mark Illing and Meyer Aaron**

The risk appetite of investors may prove to be an important concept in the analysis of financial stability. Most macroeconomic and asset-pricing models incorporate an assumption about risk appetite. The phenomenon is also often cited in the media and by public figures as a factor influencing financial markets.[1]

Theory suggests that a low appetite for risk translates into a higher cost of capital, potentially limiting business investment, while a high appetite for risk can produce booms in credit and asset prices, sowing the seeds of eventual recessions and stress on the financial system. The Asian financial crisis of 1997, the aftermath of the Russian debt default of 1998, and the collapse of high-technology share prices in 2000 are a few examples of events that appear to be related to systemic changes in investors' appetite for risk.

Not surprisingly, a growing number of financial institutions and organizations have been developing measures of risk appetite in an effort to quantify this phenomenon. These range from the International Monetary Fund's risk appetite index, used for market surveillance (IMF 2003), to indexes developed by private financial institutions to enhance trading returns.

In this article, we provide an overview of the methodologies underlying various measures of risk appetite available in the public domain. Using simple qualitative criteria, we find that these measures do not always tell the same story, even though all purport to be measuring the same thing. We therefore conclude that the measurement of risk appetite is highly sensitive to the chosen methodology and underlying theory. Consequently, it seems premature to rely on any particular index when assessing risk appetite in the financial system.

Concepts

Investors can display various attitudes towards a given level of risk: disliking risk (risk averse), being neutral to risk (risk neutral), or loving risk (risk loving). These attitudes are summarized by the Arrow-Pratt coefficient of risk aversion in classical economics.

Although most economists equate risk appetite with the Arrow-Pratt coefficient, a broader definition posits that risk appetite also incorporates risk *perceptions* (i.e., the degree of risk that investors believe they are faced with).[2] The empirical challenge arises from the fact that both attitudes and perceptions are intangibles and must therefore be inferred from the data. This typically requires making some strong assumptions.

Empirical Approaches

Most of the indexes surveyed treat risk appetite as a combination of attitudes and perceptions. Various frameworks are used to assess the changes in risk appetite typically inferred by changes in a representative risk premium or by changes in portfolio holdings. Since price data are more readily available than portfolio data, changes in risk premiums are usually taken to be the primary indicator of changing risk appetite.

Although the indexes surveyed have different titles, the concept of risk appetite is implicit in

1. See Dodge (2003), Kennedy (2002), Greenspan (1999, 2004), and Bernanke (2003).

* The authors would like to thank Miroslav Misina for contributing to our discussions and understanding of risk appetite.

2. See Cochrane (2001), Gai and Vause (2004), and Misina (2003) for a more detailed development of these concepts.

their methodology and interpretation. These measures are variously referred to as indexes of "risk aversion," "risk appetite," "investor confidence," and "investor sentiment." Generally, they measure risk appetite either by looking at a specific aspect of markets (and sometimes a specific market) or by combining information from various markets into a composite measure. They all purport to describe risk appetite in equity markets, or in all markets including the equity market. We categorize the indexes into two groups: *atheoretic* and *theory-based*.

Atheoretic indexes aggregate information from various financial markets using statistical methods. These include: the JPMorgan Liquidity, Credit, and Volatility Index (LCVI), the UBS Investor Sentiment Index (UBS), the Merrill Lynch Financial Stress Index (ML), and the Westpac Risk Appetite Index (WP).

Since these measures combine many different types of risk (liquidity, credit, and market risks), the subcomponents do not always move together. The stated benefit of combining the components is to capture overall risk appetite. Box 1 contains a list of each index's components and a brief description of their methodologies.

Theory-based indexes originate from economic or financial models and typically focus on specific markets. These include: the Tarashev, Tsatsaronis, and Karampatos Risk-Appetite Index, developed at the Bank for International Settlements (BIS); the Gai and Vause Risk-Appetite Index, developed at the Bank of England (BE); the Credit Suisse First Boston Risk-Appetite Index (CSFB); the Kumar and Persaud Global Risk-Appetite Index (GRAI), used by both the IMF and JPMorgan; the State Street Investor-Confidence Index (ICI); and the Goldman Sachs Risk-Aversion Index (GS). A brief description of each is given in Box 2.

Finally, the Chicago Board Options Exchange Volatility Index (VIX) is included in the analysis. The VIX is commonly treated as a quick and easy proxy for risk appetite, because it is derived from S&P 500 options, which investors buy and sell to change the amount of risk to which they are exposed. The VIX is also a component of all four atheoretical indexes and is based on the same underlying data as the BIS and BE indexes.

Qualitative Assessment

In Chart 1, the various indexes are rebased to a common scale.[3] Higher values can be interpreted as indicative of greater risk appetite. Most of the indexes are available only from late-1998 onwards. Nonetheless, this five-year period witnessed several interesting episodes of extreme investor optimism and pessimism that widely affected the global financial system.

Specifically, one would expect the indexes to signal a high degree of risk appetite during the bull markets of the late 1990s and 2003. Conversely, a signal of low risk appetite should appear during the 1998 Russian debt crisis, the bear market of 2000 to 2002, and the aftermath of 11 September 2001. Table 1 lists the indexes and their respective signals of risk appetite during these five episodes.[4]

All of the indexes identify the Russian crisis as a period of low risk appetite. Also, as expected, most of the indexes indicate high risk appetite at some point in 2003. The results for the other episodes are less consistent, with the BE, BIS, GRAI, and WP each giving at least one contradictory signal. On the other hand, the CSFB, ML, and UBS give the expected signal in four or more cases. It should be noted that some of the indexes were designed to perform well "in sample" with respect to recent financial crises, but their value in anticipating new crises may be limited.

Despite this apparent conformity, most of the indexes are volatile and, as a result, often give multiple signals in a given period and seemingly spurious signals during periods where no systemic events can be identified. The timing of the signals is also highly variable across the indexes, with some reacting more quickly than others.

Most of the measures are positively, but not highly, correlated with one another (Table 2).[5] This suggests that even if the indexes generally

3. The units of each index are arbitrary, so these transformations do not change their interpretations.
4. The signal thresholds are based on one standard deviation from the mean of each index (for the period 1999 to 2004) and are scored as being correct if they crossed this threshold during the term of the specific episode.
5. The correlations are statistically significant at the 5 per cent confidence level in 34 of the 55 pairs.

Box 1

Methodologies of Atheoretic Indexes

The components of the four atheoretic risk-appetite indexes considered in this article are listed in the accompanying table. For a complete description of each variable and the justification for its inclusion in a particular index, we refer the interested reader to the references listed at the end of this article.

Generally speaking, these variables are common measures of broad financial market risks (such as bond spreads, implied volatilities, and swap rates). Others are anecdotally suggestive of risk appetite. For example, one often reads that the price of gold, the value of the Swiss franc, or the Treasury-eurodollar spread increase when investors are "fleeing to safety." Similarly, during such episodes, low-risk assets tend to perform better, in terms of returns, than high-risk assets.

The obvious criticism of the atheoretic approach is that these variables are influenced by numerous factors in addition to changes in investors' risk appetite.

A further complication is how to aggregate the variables and interpret the final values of the indexes. All four indexes transform their underlying data so that each variable has roughly the same variance and, therefore, a more or less equal weight in the final index.

The UBS (Germanier 2003) and ML (Rosenberg 2003) approach is to subtract a rolling mean from each variable and divide this term by a rolling standard deviation (this is sometimes called a "σ–score"). The LCVI (Kantor and Caglayan 2002) transforms each variable into a percentile based on its historical distribution. The WP (Franulovich 2004) converts each variable to a daily percentage change, averages these values, backwardly iterates an index based on these average changes, and then converts the index into a σ–score.

Components of Atheoretic Indexes

Variables	LCVI	UBS	ML	WP
Fixed-income market				
Spreads on U.S. high-yield bonds	X	X	X	X
U.S. swap rates	X		X	X
U.S. Treasury-eurodollar spread			X	
U.S. Treasury bid/ask spreads	X			
Spreads on emerging-market bonds	X	X		X
Equity market				
VIX[a]	X	X	X	X
Low-risk/high-risk equity price ratio		X	X	
U.S. equity put/call ratio			X	
U.S. equity short sales/open interest			X	
Foreign exchange market				
Implied currency volatilities	X	X		X
Swiss franc/Australian dollar ratio			X	
Other market variables				
Gold price		X	X	
Treasury/equities total returns ratio		X	X	
GRAI[b]	X			

a. Chicago Board Options Exchange (2004) implied volatility index for the S&P 500
b. Global Risk Appetite Index (Kumar and Persaud 2002)

Box 2

Methodologies of Theory-Based Indexes

Tarashev, Tsatsaronis, and Karampatos (2003) Risk-Appetite Index, developed at the Bank for International Settlements (BIS)

The BIS method begins by estimating the statistical distribution of future asset returns from the historical patterns of asset prices using a GARCH model. Implied volatilities are then calculated using option prices with different exercise prices. From this, a volatility "smile" is mapped into a "subjective" probability distribution of the future payoffs.

The value of the index is the ratio of the left tails of the two distributions (i.e., the ratio of the statistical downside risk to the subjective downside risk). The BIS uses monthly equity market data.

Gai and Vause (2004) Risk-Appetite Index, developed at the Bank of England (BE)

The BE approach is very similar to the BIS method. The key difference is that the BE uses the ratio of the full distributions rather than just the ratio of the left tails.

Kumar and Persaud (2002) Global Risk-Appetite Index (GRAI)

To construct the GRAI, assets are first ranked by their riskiness (proxied by the variance of past returns) and then ranked by their excess returns (proxied by the difference between future and spot prices measured at a single point in time). The key premise is that the correlation between the ranking of risk and the ranking of excess returns should be close to zero for changes in asset riskiness. This correlation should be positive for increasing risk appetite and negative for decreasing risk appetite. The GRAI uses daily foreign exchange rate data. The index methodology is used by both the IMF and JPMorgan in their respective risk-appetite indexes.

The Credit Suisse First Boston Risk-Appetite Index (CSFB) (Wilmot, Mielczarski, and Sweeney 2004)

The CSFB is similar to the GRAI. The index compares risk (past price volatility) and excess returns across assets. The value of the CSFB on a given day is the slope coefficient obtained from the cross-sectional linear regression of risk and excess returns. The more positive the slope, the greater the risk appetite. The CSFB is based on daily data for 64 indexes of bonds and equities in developed and emerging markets. Daily indexes of local currencies are used for developed markets, while daily U.S.-dollar indexes are used for emerging markets.

State Street Investor-Confidence Index (ICI) (Froot and O'Connell 2003)

The ICI is also similar to the GRAI but is applied to quantities rather than prices. Higher risk appetite should be observed through increased holdings of risky assets and vice versa. These portfolio shifts can occur in times of increasing or decreasing prices. Hence, the ICI claims to be able to differentiate between changes in risk appetite and changes in risk. The index is calculated monthly using State Street's proprietary database of institutional investor portfolios.

Goldman Sachs Risk-Aversion Index (GS)

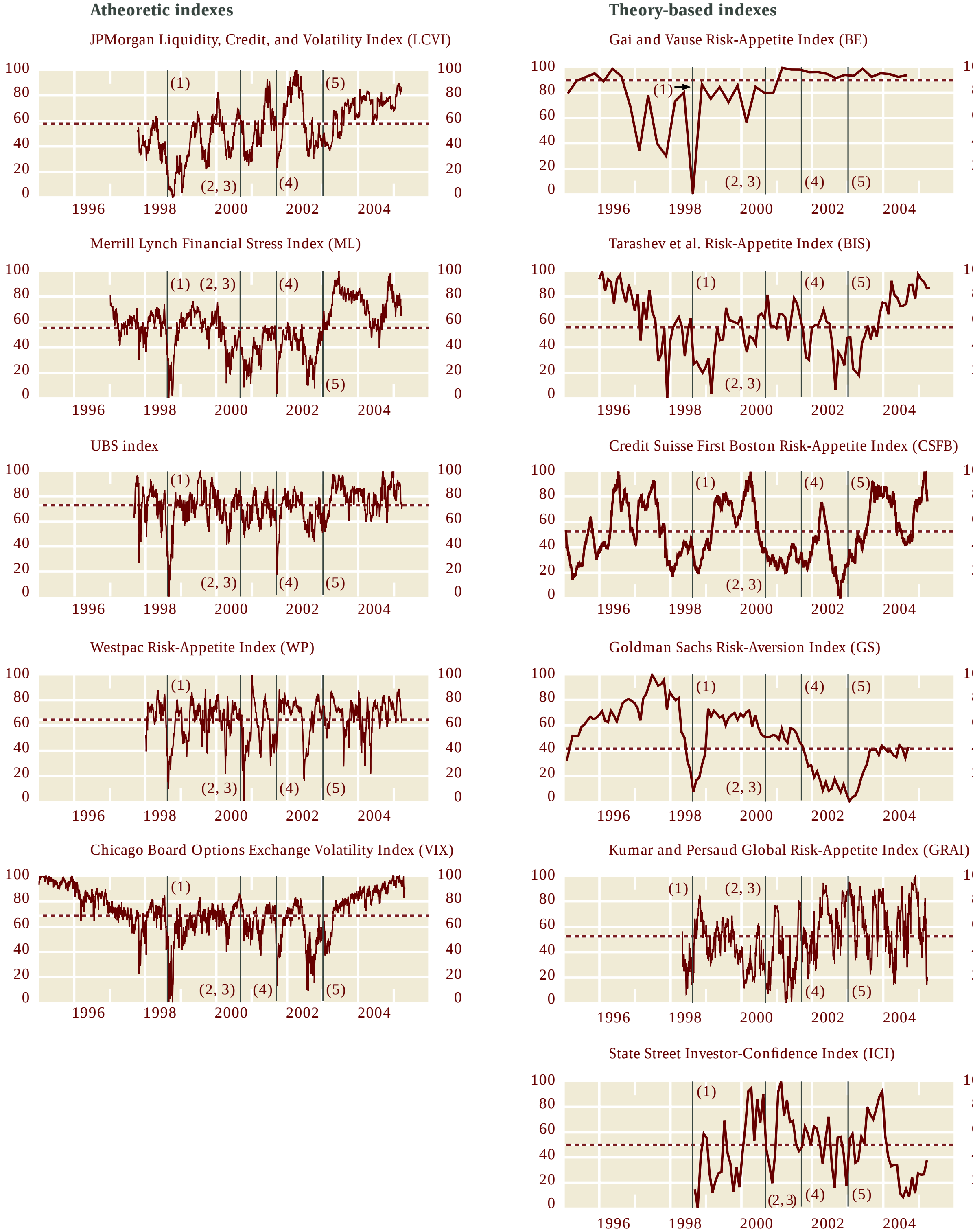
The GS uses a standard consumption model of capital-asset pricing, where the Arrow-Pratt coefficient of risk aversion is allowed to vary over time. The premise derives from the observation that the "volatility of excess returns from holding stocks over bonds appears to be substantially higher than the volatilities of T-bills and consumption, and only a time-varying risk aversion level can explain such [a] differential" (Goldman Sachs 2003). The GS uses monthly data on real U.S. per-capita consumption, the real rate on 3-month U.S. Treasury bills, and the inflation-adjusted S&P 500 Index.

Characteristics of Theory-Based Indexes

	BIS	BE	GRAI	CSFB	ICI	GS
Interpretation of values:						
Level	X	X			X	X
Change			X	X		
Underlying data from[a]:						
Equity	X	X		X	X	X
Fixed income				X		X
Foreign exchange			X			
Frequency[b]:						
Quarterly		X				
Monthly	X				X	X
Daily			X	X		

a. The methodologies could be equally applied to other asset markets, provided the requisite data existed.
b. The BIS and BE methodologies could be applied to daily data, although this would be computationally intensive.

Chart 1 Risk-Appetite Indexes



Note: Variables rescaled such that 100 equals maximum "risk appetite" and 0 equals minimum "risk appetite" over the period 1996 to 2004. The dotted horizontal line depicts the average of each index over this period.

Vertical solid lines correspond to:
(1) 1998 Russian debt default
(2) Peak of 1990s bull market, 2000
(3) Start of 2000–2002 bear market
(4) Terrorist attacks of 11 September 2001
(5) Start of 2003 bull market

provide the expected signal of risk appetite, these signals are not consistently the same across indexes.[6]

Interestingly, the theory-based measures are either orthogonal to one another (having small and non-significant correlations) or negatively correlated. Recall that the BIS, ICI, and GS are all based on equity market data, yet they have some of the lowest cross-correlations. As well, the CSFB measure is orthogonal to the GRAI, even though both use a similar risk-return framework.

Of course, the absence of correlation may simply reflect different information sets and design objectives for the various indexes. One of them may still be an appropriate measure of overall risk appetite even if it is not highly correlated with any of the others.

Conclusions

The ability to measure the appetite of investors for risk is an appealing proposition, given the recent spate of systemic financial shocks (such as the Asian and Russian crises and the bursting of the high-tech bubble). This explains the growing interest in the measurement of risk appetite and the proliferation of indexes. If all of these indexes truly captured changes in risk appetite, however, we would expect them to provide similar signals. Our survey indicates that this is generally not the case. Consequently, it seems premature to rely on any given index when assessing risk appetite in the financial system.

Further research is needed to explore the empirical properties of these indexes and their theoretical underpinnings. The index that proves most useful from a central bank perspective will be the one that establishes a (possibly non-linear) link between the level of risk appetite and changes in the supply of credit, asset prices, business investment, or more broadly, the functioning of the financial system.

6. Many of the measures that are significantly correlated with the VIX include it as a component.

Table 1

Risk-Appetite Signals

This table characterizes the signal given by each index during five periods (L for low, — for neutral, and H for high risk appetite).

	1998 Russian crisis	1990s bull market	2000 bear market	11 Sept. 2001	2003 bull market
Expected signal:	Low	High	Low	Low	High
BE	L	L	—	H	H
BIS	L	—	H	L	H
CFSB	L	H	L	L	H
GRAI	L	L	L	—	H
GS	L	H	—	—	—
ICI	L	H	—	—	H
LCVI	L	—	—	L	H
ML	L	—	L	L	H
UBS	L	H	—	L	H
VIX	L	—	—	L	H
WP	L	—	L	H	—

The signal thresholds are +/- 1 standard deviation from the mean of each index over the period 1999 to 2004.
1998 Russian crisis refers to Russia's debt default and subsequent turbulence in global markets over the August to October period in 1998.
1990s bull market refers to the 15 months leading up to February 2000.
2000 bear market refers to the third quarter of 2000, which marked the start of the broad-based collapse of share prices in the high-tech sector.
11 Sept. 2001 refers to the month following the terrorist attacks of 11 September 2001.
2003 bull market refers to the rebound in equity markets, the prices of emerging-market bonds, and the prices of high-yield corporate bonds during 2003.

Table 2

Correlation Matrix

Per cent

	BE	BIS	CSFB	GRAI	GS	ICI	LCVI	ML	UBS	VIX
BIS	25*									
CFSB	-41**	34**								
GRAI	42**	0	-2							
GS	-60**	24*	43**	-55**						
ICI	21*	15	3	-9	0					
LCVI	54**	29**	19	30**	-55**	10				
ML	16	20	59**	27*	5	-2	54**			
UBS	28**	31**	44**	21*	4	13	54**	75**		
VIX	11	71**	66**	3	27*	4	48**	66**	68**	
WP	24*	2	12	27*	-11	12	40**	32**	57**	23*

Asterisks denote significance at the 5 per cent (*) and 1 per cent (**) confidence levels. The sign of the cross-correlations is adjusted where appropriate such that a positive value indicates positive correlation of risk appetite, and vice versa. Pairwise, correlations involving the BE are calculated quarterly, while all others are monthly.

References

Bernanke, B. 2003. "Balance Sheets and the Recovery." Remarks at the 41st Annual Winter Institute, St. Cloud State University. Available at <http://www.federalreserve.gov/boarddocs/speeches/2003/20030221/default.htm>.

Chicago Board Options Exchange. 2004. Documentation for VIX. Available at <http://www.cboe.com/micro/vix/introduction.aspx>.

Cochrane, J. 2001. *Asset Pricing*. Princeton, N.J.: Princeton University Press.

Dodge, D. 2003. "Proceedings of the Standing Senate Committee on Banking, Trade and Commerce." Issue 17–Evidence. 30 April. Available at <http://www.senate-senat.ca/BANCOM.asp>.

Franulovich, R. 2004. Personal email correspondence.

Froot, K.A. and P.G.J. O'Connell. 2003. "The Risk Tolerance of International Investors." National Bureau of Economic Research Working Paper No. 10157.

Gai, P. and N. Vause. 2004. "Risk Appetite: Concept and Measurement." *Bank of England Financial Stability Review* (December): 127–36.

Germanier, B. 2003. "Updated Risk Index." In *UBS: Foreign Exchange Note* (occasional publication available only by subscription). (September).

Goldman Sachs. 2003. "Risk Aversion." In *The Foreign Exchange Market* (occasional publication available only by subscription). (October): 28–31.

Greenspan, A. 1999. "New Challenges for Monetary Policy." Remarks at Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, 27 August. Available at <http://www.federalreserve.gov/boarddocs/speeches/1999/19990827.htm>.

Greenspan, A. 2004. "Globalization and Innovation." Remarks at the Conference on Bank Structure and Competition, Chicago, 6 May. Available at <http://www.federalreserve.gov/boarddocs/speeches/2004/200405062/default.htm>.

International Monetary Fund (IMF). 2003. *Global Financial Stability Report*. Chapter 3 (March).

Kantor, L. and M. Caglayan. 2002. "Using Equities to Trade FX: Introducing the LCVI." JPMorgan Global Foreign Exchange Research, Investment Strategies: No. 7.

Kennedy, S. 2002. "The Bank of Canada's Interest in Financial Markets." Remarks to the Treasury Management Association of Canada and Saskatchewan Society of Financial Analysts, Regina. Available at <http://www.bankofcanada.ca/bocmmbdc/spee-disc/kennedy281002.html>.

Kumar, M. and A. Persaud. 2002. "Pure Contagion and Investors' Shifting Risk Appetite: Analytical Issues and Empirical Evidence." *International Finance* 5: 401–36.

Misina, M. 2003. "What Does the Risk-Appetite Index Measure?" Bank of Canada Working Paper No. 2003-23.

Rosenberg, D. 2003. "Introducing Merrill Lynch's Proprietary Weekly Indicators." In *Merrill Lynch: The Market Economist* (occasional publication available only by subscription). (June): 4–10.

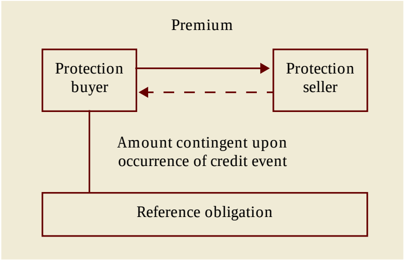
Tarashev, N., K. Tsatsaronis, and D. Karampatos. 2003. "Investors' Attitude Towards Risk: What Can We Learn from Options?" *BIS Quarterly Review* (June): 57–65.

Wilmot, J., P. Mielczarski, and J. Sweeney. 2004. "Global Risk Appetite Index." In *Credit Suisse First Boston: Global Strategy Research: Market Focus* (occasional publication available only by subscription). (February).

Credit Default Swaps and the Canadian Context

Christopher Reid

Credit Default Swap



A significant aspect of the evolution of credit markets has been the development of credit-risk transfer through the use of derivatives.[1] Globally, one of the fastest-growing derivative products is the credit default swap (CDS). This article describes the basic mechanics of a CDS, assesses the impact of CDSs on market efficiency, and considers the implications of the growing market for CDSs for financial stability. Finally, the current state of the CDS market in Canada is assessed, together with the outlook for the future.

The Mechanics of a Credit Default Swap

A credit default swap can be thought of in simple terms as default insurance on a loan or bond (the "reference obligation"). A CDS provides the buyer with compensation should a prespecified credit event occur.[2] In return for this protection, the seller receives a premium in the form of an annuity until the time of the credit event or the maturity date of the swap (see diagram). In theory, a CDS premium represents a pure measure of the underlying credit risk that can be either bought or sold. It should, therefore, be closely related to a bond yield spread or to the excess yield over a risk-free rate.[3]

1. A derivative, in the broadest sense, is a financial instrument whose payoff depends on another financial instrument. A credit derivative is a specific contract that transfers credit risk between counterparties without transferring ownership of the underlying asset (unless a "credit event" occurs).
2. Credit events include failure to pay, bankruptcy, repudiation/moratorium, obligation acceleration, and restructuring. Credit events applicable to a CDS contract vary depending on region and on the credit rating of the reference obligation.
3. This relationship ignores the differences in funding risk.

A CDS allows investors who hold a pre-existing amount of marketable corporate debt to alter their exposure to credit risk without altering the underlying portfolio. However, as is discussed below, a pre-existing position is not necessary, and a CDS can be used to create a synthetic exposure to credit risk.

As is discussed later, altering credit-risk exposure through the use of a CDS can be more cost-effective than transacting in the secondary market. As a result, the use of CDSs is becoming a universal mainstay of portfolio management.

Impact of CDSs on Market Efficiency

Theory suggests that the presence of an active market for credit derivatives should add to the overall liquidity of the credit market, since derivatives are linked to the underlying security by an arbitrage condition, rendering the two products substitutes (albeit imperfect ones). An increase in liquidity should translate into efficiency-related gains, such as lower transactions costs and greater price discovery. The reality of the Canadian market, however, is that efficiency gains from CDSs have likely been modest to date.

It is important to note that a CDS is not simply an insurance product that pays if a credit event occurs. A CDS also represents a market price on the probability of such an event (and the associated recovery rate) and as such is a dynamic and tradable asset. More specifically, investors would be willing to buy a CDS without owning the underlying asset if they expected the credit risk of the underlying asset to increase, hence raising the value of the insurance against default. Adopting a long CDS position without owning the reference obligation, in addition to lending at the risk-free rate, is akin to selling short a bond of the same reference entity but without the need to borrow the security in the repurchase market.[4] Shorting corporate bonds can be difficult, since they typically trade infrequently and because the market for corporate debt is relatively small compared with government or agency markets. The CDS market thus represents an attractive alternative for an investor who wants to short a corporate bond in a cost-effective manner. CDSs enable participants to take alternative views (long or short) on the fundamental value of a corporate bond. This, in turn, implies that more information is captured in corporate bond prices, hence increasing the efficiency of the corporate bond market.

CDSs addressed two shortcomings of the market for credit derivatives: a lack of standardization and a lack of price transparency. Kiff and Morrow (2000) suggest that the complexity and lack of standardization of credit risk have resulted in credit derivatives being less of a commodity than, for example, interest rate derivatives. This has been an impediment to the growth of this market. The lack of standardization might therefore suggest that credit derivatives may not garner the efficiency gains associated with other derivative products. To overcome this obstacle, CDSs have been designed with the specific purpose of creating a standardized instrument. As a result, credit default swaps are now the most actively traded credit derivative product. In 2003, $1.9 trillion in gross notional amount was sold globally (Fitch Ratings 2004a), and they have become a benchmark in pricing credit.[5] Furthermore, CDSs now represent a building block for a new generation of products, such as synthetic collateralized debt obligations (CDOs), single-tranche CDOs,[6] and CDS indexes (Box 1).

Although CDSs trade on an over-the-counter basis, a number of brokers provide quotes, thus providing a medium for price discovery. Price transparency is less of an issue with CDSs than with other forms of credit-risk transfer. For example, collateralized debt obligations and asset-backed securities are usually aimed at buy-and-hold investors, making it difficult to find accurate pricing in the secondary market.

Continued improvements in liquidity and product development should translate into further efficiency gains. Global liquidity in CDSs

4. In practice, this arbitrage relationship does not strictly hold because of differences in the liquidity of the various components. This difference is referred to as the “basis” and is typically small.

5. Rather than using a corporate bond spread to price a CDS, the information flow is increasingly in the other direction. That is, CDS spreads are now used, more so in Europe and increasingly in the United States, to express indicative levels in marketing new debt offerings.

6. For more details on synthetic and single-tranche collateralized debt obligations, see Armstrong and Kiff on page 53 of this *Review*.

Box 1

A New Product: CDS Indexes

The introduction of CDS indexes allows investors to buy and sell exposure to a basket of CDS contracts, making it easier to take a position in specific credit markets or market segments.

Owning a CDS index is similar to owning a portfolio of single-name CDSs. The price of the index reflects an equally weighted average of CDS spreads for a predetermined basket of CDS contracts (usually 100 to 125 names per portfolio). The indexes are first grouped by geography and exist for North America, Europe, Japan, and emerging markets. They are then broken down further by the credit quality of the reference obligation (e.g., North American High-Yield). Unlike perpetual equity indexes, CDS indexes have a fixed composition and maturity date, with a new index launched twice a year.

Initially, there were two major CDS indexes: iBoxx and Dow Jones TRAC-X. Both provided products for Europe, the United States, and Asia. The presence of two competing platforms hampered liquidity and was viewed as limiting the growth of the CDS-index market. In April of 2004, a merger was announced between iBoxx and TRAC-X's European and Asian index products. The merged indexes are now referred to as the Dow Jones iTraxx. The North American credit indexes were not included in this initial arrangement but were later merged and now trade as the Dow Jones CDX indexes.

Both the iTraxx and CDX indexes are supported by the dealer community as a way for investors to gain access to diversified credit exposure. The strong support of the dealer community has created liquidity, which is, in turn, cited as a key reason for this product's success. A study by the BIS states that the liquidity of CDS indexes has remained robust even when the markets for the underlying single-name CDSs are less liquid. Not surprisingly, the depth of the market and speed of transaction are given as key reasons for the success of this product. However, the current volume of notional trades in the North American indexes remains relatively small compared with the volume of more established interest rate derivative products.

A CDS index does not currently exist for Canada, and only eight Canadian reference entities are included in the various North American indexes. The universe of liquid CDSs on Canadian-based entities is too small to create a diversified index.

with a single underlying reference obligation has improved significantly over the past two years.[7] However, some challenges remain. Liquidity in distressed names[8] has been problematic in the past, with liquidity evaporating even in the top names (Fitch Ratings 2004b). This suggests that the CDS market is still in its developing stage and continues to suffer from structural demand/supply imbalances.

The range of single-name CDS products, while growing, still remains limited. Globally, the market for CDSs remains predominately focused on investment-grade corporate entities despite growth in other areas. In addition, CDS contracts are based on standard time frames, which facilitate liquidity, but this usually results in a duration mismatch between the derivative and the underlying asset. The market for CDSs is most liquid in the five-year sector, although there has been some effort to expand the maturity spectrum to 10 years.

Implications for Financial Stability

The impact of credit derivatives on the financial system has been the subject of some debate. While CDSs clearly add to the stability of the financial system in some areas, they present a potential risk in others.

The efficiency gains associated with CDSs should allow for more accurate pricing of credit risk, which should improve a financial institutions's overall risk management. CDSs may even increase the willingness of lenders to take on credit risk, thus reducing the probability of possible credit crunches. More directly, the benefits of CDSs to stability are related to the increased ability to hedge, the possibility of greater diversification, and the ability to transfer risk to those most willing to bear it.

CDSs enable financial-asset managers to better hedge and alter credit risk. Altering credit risk by buying and selling corporate debt in the secondary market can be expensive and difficult to accomplish on a timely basis. CDSs can reduce portfolio volatility by allowing greater access to hedging of credit risk. In Canada, however,

7. A CDS can also be written on a basket of underlying securities.
8. This refers to the liquidity of CDSs written on companies with deteriorating credit positions.

liquid CDS contracts currently exist only for companies whose debt is already liquid and actively traded. Therefore, the contribution that CDSs can make to the stability of the Canadian financial system by allowing easier hedging of credit risk is probably fairly small at this stage. But if Canada's CDS market continues to grow, the increasing ability to hedge credit risk could contribute to the stability of the Canadian financial system.

The use of CDSs can also improve the management of credit risk by allowing greater diversification and an increased ability to take on credit risk. This is particularly true for banks, whose credit exposure would otherwise reflect their loan books and who, as a result, may not be optimally diversified. Credit derivatives have also been used in Canada to achieve diversification on an international basis without contravening foreign-content rules for pension plans. This increase in diversification added to stability by reducing the unsystematic risk of investor portfolios. However, the proposal in the February 2005 federal budget that the foreign-content rule will be eliminated, would imply a reduction in the demand for CDSs to achieve this kind of diversification.

Finally, CDSs make it easier to transfer credit risk. This allows greater dispersion of credit risk to a wider range of investors and to those most willing to bear it. In the wake of several high-profile defaults in 2002 (e.g., Enron and World-com), Alan Greenspan, Chairman of the U.S. Federal Reserve Board, argued that credit derivatives helped diversify the losses across a greater number of stakeholders, thereby reducing the amount of stress on the financial system (Greenspan 2002).

Despite their benefits, CDSs also pose potential risks to the stability of the financial system. Credit derivatives are by design highly leveraged, which can lead to concentration of risk. The immediacy and magnitude of this risk are, moreover, hard to quantify because of a lack of transparency. Market participants have acknowledged these shortcomings and are actively working towards mitigating these risks.

The ability to establish a leveraged position means that risk positions can be accomplished without a large investment in the underlying financial asset. This, in turn, implies a greater ability to easily take on a large amount of risk, which may translate into a significant loss. In the past, highly leveraged products, particularly new products that may not be well understood by all investors, have led to some notable financial stresses.[9]

The ability to establish a leveraged position using credit derivatives implies not only that risk can be more widely dispersed, but equally that it can also become more concentrated. CDSs effectively increase the amount of outstanding long and short credit positions. Since these increases are directly proportional to each other (shorts equal longs), the net amount of credit risk in the financial system remains unchanged. But the overall increase in credit positions in the financial system could lead to a greater concentration of risk among a few participants, which could potentially exacerbate the impact of a credit event on the financial system.

Market participants have been trying to lessen this risk by improving collateral and netting arrangements. In a recent assessment of global credit derivatives markets, the Bank for International Settlements (BIS) concluded that there does not seem to be any evidence that the transfer of credit risk has led to an increase in the concentration of risk (BIS 2004). The BIS notes, however, that there is insufficient information to assess the impact of credit-risk transfer on the stability of the financial system.

The BIS concluded that balance sheets and financial statements do not provide a sufficiently clear assessment of a firm's activities in transferring credit risk, and it is therefore not possible to track the redistribution of risk or to properly identify concentrations. This lack of transparency is particularly acute for risk taken on by unregulated market participants, such as hedge funds, which are increasing their presence in the credit derivatives market. The lack of transparency may limit the ability of the market to discipline publicly traded companies that use leverage in an inappropriate manner.

The CDS Market in Canada

Quantifying the growth of CDS activity in Canada remains difficult, because CDSs are private bilateral contracts, and participation in data collection is voluntary. Notional amounts of CDS

9. One example would be interest rate derivatives and the bankruptcy of California's Orange County.

Table 1

Notional Amounts of Outstanding Credit Default Swaps for Three Participating Canadian Banks (as at year-end 2004)

US$ millions

Counterparty	Bought	Sold
With reporting dealers	20,465	26,511
With other financial institutions	41,290	59,626
Banks and securities firms	40,529	48,200
Insurance and pension funds	329	89
Hedge funds	0	0
Other	432	537
Non-financial customers	3,631	10,010
Total	65,386	81,402

contracts outstanding are currently available for only three of Canada's five largest banks, and for only one date: year-end December 2004 (Table 1). Owing to data limitations, this article also draws on informal interviews with market participants and information available from rating agencies. From the available evidence, it can be deduced that Canadian participation in CDSs is currently limited.

Credit default swaps written on Canadian entities trade on a U.S.-dollar basis and over-the-counter (no organized exchange). Therefore, the current state of the CDS market in Canada is based on financial institution transactions in CDSs, as well as on the breadth of contracts written on Canadian-based entities.

North American banks, brokerages, and dealers together held US$2.7 trillion in outstanding credit derivative positions in 2003, with slightly over a trillion dollars of this total in the form of CDSs (Fitch Ratings 2004a). Although a country-specific breakdown is not available, conversations with Canadian securities dealers suggest that the outstanding positions of Canadian institutions likely represent only a small percentage of these totals. Indeed, for the three Canadian banks for which data are available, only US$150 billion in single-name CDS contracts outstanding (both long and short) are reported.

Despite the lower level of activity compared with U.S. financial institutions, the major Canadian banks are increasingly active in all aspects of the credit-risk-transfer market. Recently, Canadian banks have broadened their activity to include the use of the CDS market to manage credit risk in their loan portfolios. CDSs are also becoming a source of revenue from intermediation, since Canadian dealers have increased their participation in trading CDSs.

Non-financial corporations are one of the largest counterparties with the reporting banks. They use CDSs mainly to hedge future funding requirements. If a company's credit conditions worsen, making funding more expensive, this cost may be offset with the protection of a pre-existing CDS position.

Some of the larger Canadian pension funds have also entered the CDS market as a way of gaining synthetic credit exposure. Anecdotal evidence suggests that to further diversify their portfolios, these funds have been most active in the deeper, more liquid credit derivatives, which are based on foreign rather than domestic companies. As a result, the extent of their participation may be understated by their outstanding positions with reporting banks, which is quite modest.

Interestingly, international insurance companies are, overall, among the most active participants globally in the CDS market, while Canadian insurance companies are only modestly active, either domestically or internationally. Also of note in terms of international comparisons, reporting Canadian banks have no CDS positions with hedge funds, which are large participants in the CDS market in both Europe and the United States.

Over the past two years, dealers have witnessed strong growth in the demand for CDSs by Canadian-based institutions. Dealers express confidence that activity in CDSs outside the interdealer market will continue to increase as new accounts put documentation in place, augment their expertise, and enhance their financial systems in order to be able to deal in this product.

Quotations for CDSs are available for as many as 160 Canadian-based reference entities. Trading activity among these 160 names can be broken down into three tiers. The top tier includes five to ten names that are extremely liquid and in which there is a regular two-sided market. Approximately 20 additional Canadian names trade on a semi-regular basis. The bid/ask spreads of the first and second tiers are typically around 5 basis points (however, this may be indicative only for small volumes). The liquidity of the remaining 130 Canadian-based entities, or the third tier, is essentially nil, with any trade in these names being difficult to find. Approximately 2,100 reference obligations trade globally (Fitch Ratings 2004b); therefore, CDSs written on Canadian-based entities represent only a very small fraction of the global market.

Growth of CDSs in Canada

The Canadian corporate debt market represents about 1.2 per cent of the global corporate market (Merrill Lynch 2004). While CDSs written on Canadian-based entities form a relatively new market that continues to grow, its share of the global CDS market is comparable to Canada's share of the global corporate bond market. The growth of CDSs in Canada should continue to be closely linked to the global growth of CDSs (in proportion) and to changes in Canada's share of the global corporate market. While Canada's corporate debt market is only a small percentage of the global market, it is important to note that both CDSs and the Canadian corporate debt market have also grown rapidly over the past 5 to 10 years (Anderson, Parker, and Spence 2003).

Key factors in the growth and liquidity of CDSs are the amount of credit information available to investors and the amount of outstanding debt. Both are correlated with the size of the corporate market. The use of CDSs results in the transfer of credit risk to those who often do not share a lending relationship with the underlying entity. Therefore, the new holder of credit risk does not have access to the same level of fundamental credit knowledge as the loan originator. As a result, there is an increase in the dependence on credit-rating agencies and independent analysis to obtain credit information. Since both the rating process and internal analysis are costly, it is not surprising that the most actively traded CDSs on Canadian reference entities include some of Canada's largest companies.

In addition to the impact of the size of the Canadian corporate debt market on the development of a CDS market, its composition may be a factor. The recent global search for yield by investors has, in part, driven the strong growth of CDSs written on high-yield debt. The high-yield market in Canada is much smaller than that of the United States (Anderson, Parker, and Spence 2003), which may further help to explain the difference in the rate of adoption of CDSs.[10]

Conclusions

Credit default swaps have become one of the most widely used credit derivatives because they address two shortcomings of the credit derivatives market: a lack of standardization and a lack of price transparency. CDSs also add to the completeness of the corporate debt market by increasing the ability of investors to short corporate bonds, which augments the information content

10. In terms of the reporting banks, the notional amount of CDS positions on debt that is either unrated or rated BB and below was roughly 15 per cent of total positions outstanding.

of corporate bond pricing and the efficiency of the market. Although hard to quantify, CDS activity in Canada to date has probably had a limited but positive effect on market efficiency. Credit derivatives in general should add to the overall liquidity of the credit debt market, which in turn should lead to lower transactions costs and greater price discovery.

CDSs contribute to financial stability by facilitating the ability to hedge credit risk and improve diversification, as well as by allowing credit risk to be held by those most willing to bear it. While CDSs contribute to financial stability, they also pose the risk that leverage will be employed to concentrate rather than diversify credit risk.

References

Anderson, S., R. Parker, and A. Spence. 2003. "Development of the Canadian Corporate Debt Market: Some Stylized Facts and Issues." *Bank of Canada Financial System Review* (December): 35–41.

Armstrong, J. and J. Kiff. 2005. "Understanding the Benefits and Risks of Synthetic Collateralized Debt Obligations." *Bank of Canada Financial System Review* (this issue).

Bank for International Settlements (BIS). 2004. *Credit Risk Transfer*. Joint Forum Report, Basel Committee on Banking Supervision (October). Available at <http://www.bis.org/publ/joint10.htm>.

Fitch Ratings. 2004a. "Global Credit Derivatives Survey: Single-Name CDS Fuel Growth." Special Report (September).

———. 2004b. "CDS Market Liquidity: Show Me the Money." (November).

Greenspan, A. 2002. "International Financial Risk Management." Remarks before the Council on Foreign Relations, Washington, D.C. Available at <http://www.federalreserve.gov/boarddocs/speeches/2002/20021119/default.htm>.

Kiff, J. and R. Morrow. 2000. "Credit Derivatives." *Bank of Canada Review* (Autumn): 3–11.

Merrill Lynch. 2004. "Size & Structure of the World Bond Market: 2004." (May).

Understanding the Benefits and Risks of Synthetic Collateralized Debt Obligations

Jim Armstrong and John Kiff

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

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

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

In Canada, the large banks have been actively involved in the creation and distribution of these products through their global investment banking arms. Globally, CDOs are increasingly attracting the interest of institutional investors, such as insurance companies, pension funds, and hedge funds, because their yields are superior to those of conventional fixed-income instruments, and their various tranches can offer investors unique risk/return combinations. Canadian institutional investors have only recently started to use these instruments, but this is expected to increase rapidly.

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

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

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

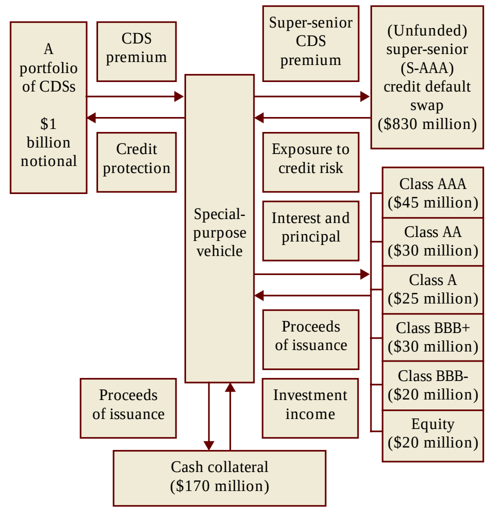
In traditional securitizations, the assets in the pool tend to be relatively homogeneous (for example, household loans, such as residential mortgages and credit card loans), and the number of tranches on the liability side tends to be small, usually comprising just the senior and subordinated tranches. The relative homogeneity of the asset pool permits credit risk in these pools (i.e., the expected losses) to be estimated with relatively reliable statistical techniques based on the "law of large numbers." The assets in the pool are segregated—typically in a trust arrangement—to secure the ABS, and they are understood to be insulated from and independent of the affairs of the firm or firms that originated and sold the assets.

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

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

Chart 1 Example of a Synthetic CDO

Synthetic Securitization Structure



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

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

The Emergence of Synthetic CDOs

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

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

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

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

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

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

Credit-Protection Structures

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

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

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

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

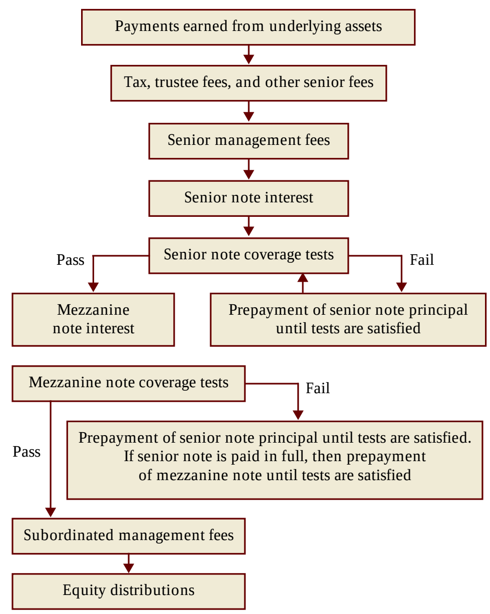
Payments earned from the underlying assets in the pool are distributed in a strict order of priority (determined in detailed transaction-specific documentation) often referred to as a "waterfall." Chart 2 presents a simplified example of this payments distribution. Typically, the fees of the asset managers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

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

What Happens When a Credit Event Occurs?

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

Chart 2 Example of a Payments "Waterfall"



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

How Does a CDO Create Value?

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

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

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

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

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

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

Assessing the Risks of CDOs

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

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

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

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

Modelling Credit Risk: Assessing the Risk in the Asset Pool

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

In addition to the expected losses of CDOs, "unexpected loss" or loss volatility can be substantial and is driven mainly by two factors: single-credit concentration and, again, default correlation. Concentration (i.e., the lumpiness of the portfolio) is linked to idiosyncratic risks. The greater the concentration, the more the portfolio is exposed to idiosyncratic risk. Default correlation, on the other hand, relates to systematic risk and reflects the sensitivity of PDs to common factors and, therefore, individual obligors' exposure to undiversifiable or business-cycle risks. It is vital to note that the estimated loss distributions of a portfolio—expected and unexpected—are highly sensitive to assumptions about default correlation.

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

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

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

Involvement by Canadian Institutions

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

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

Box 1

The Importance of the Correlation Assumption to CDO Credit Ratings

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

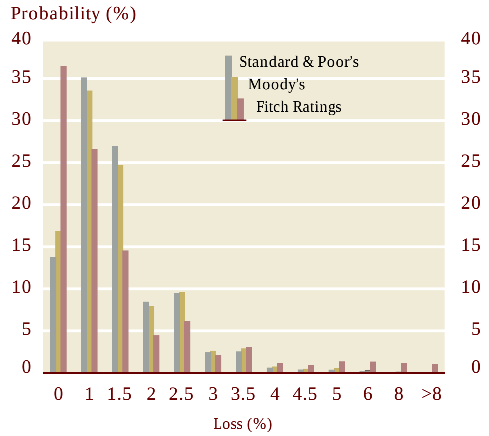
These losses can be viewed as "potential" loss distributions, because their shapes are driven by different assumptions regarding the default correlations between the 120 CDSs. For instance, S&P assumes a very high correlation between the defaults of obligors that are in the same industry sector, but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

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

Using S&P's correlation assumptions, the senior tranche's probability of default (PD) works out to around 0.9 per cent, which is the same PD associated with a five-year, AA– corporate bond. Hence, the tranche is rated AA– by S&P. However, if the heaviest Moody's correlation assumption is used, the senior tranche's PD works out to about 1.3 per cent, which would map into an A– corporate bond rating. The Fitch correlation assumption is high enough that it could actually map into a subinvestment-grade rating (below BBB–).

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

Potential CDO Loss Distributions



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

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

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

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

Conclusions

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

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

References

Adams, M., M. Jhooty, and J. Wong. 2004. *CDO Methodology*. Industry Study, Securitizations. Toronto: Dominion Bond Rating Service Limited.

Amato, J.D. and E. Remolona. 2003. "The Credit Spread Puzzle." *BIS Quarterly Review* (December): 51–63.

Ashcraft, A.B. 2005. "How Does Tranching Create Economic Value?" Federal Reserve Bank of New York Working Paper (January).

Bank for International Settlements (BIS). 2004. *Credit Risk Transfer*. Joint Forum Report, Basel Committee on Banking Supervision (August). Available at <http//www.bis.org/publ/joint10.htm>.

———. 2005. *The Role of Ratings in Structured Finance: Issues and Implications*. Working Group Report, Committee on the Global Financial System (January). Available at <http//www.bis.org/publ/cgfs23.htm>.

Fender, I. and J. Kiff. 2004. "CDO Rating Methodology: Some Thoughts on Model Risk and Its Implications." Bank for International Settlements Working Paper No. 163.

Gibson, M.S. 2004. "Understanding the Risk of Synthetic CDOs." Federal Reserve Board Finance and Economics Discussion Series No. 2004-36.

Kiff, J. 2003. "Recent Developments in Markets for Credit-Risk Transfer." *Bank of Canada Financial System Review* (June): 33–41.

Kiff, J. and R. Morrow. 2000. "Credit Derivatives." *Bank of Canada Review* (Autumn): 3–11.

Kiff, J., F.-L. Michaud, and J. Mitchell. 2003. "An Analytical Review of Credit Risk Transfer Instruments." *Banque de France Financial Stability Review* (June): 106–31.

King, M. 2003. "Income Trusts: Understanding the Issues." *Bank of Canada Financial System Review* (December): 77–79.

Lucas, D. 2001. *CDO Handbook*. JPMorgan Securities Inc. Global Structured Finance Research.

Mitchell, J. 2004. "Financial Intermediation Theory and the Sources of Value in Structured Finance Markets." National Bank of Belgium Working Paper (December).

Reid, C. 2005. "Credit Default Swaps and the Canadian Context." *Bank of Canada Financial System Review* (this issue).

Tavakoli, J.M. 2003. *Collateralized Debt Obligations and Structured Finance: New Developments in Cash and Synthetic Securitization*. Toronto: John Wiley & Sons, Inc.