Credit value adjustment

A dynamic approach to pricing and managing counterparty risk

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Executive summary

The market volatility experienced during the financial crisis has driven many firms to review their methods of accounting for counterparty credit risk. The traditional approach of controlling counterparty credit risk has been to set limits against future exposures and verify potential trades against these limits. Credit Value Adjustment (CVA) offers an opportunity for banks to move beyond the control mindset of limits by dynamically pricing counterparty credit risk directly into new trades. Many banks already measure CVA in their accounting statements, but the financial crisis has led pioneering banks to invest in systems that more accurately assess CVA, and integrate CVA into pre-deal pricing and structuring. Their expected return on investment is the ability to support future growth by freeing up more capital and minimizing earnings volatility.

As part of ongoing research, Algorithmics has conducted in-depth interviews with risk professionals to gain insight into the approach their firms are taking on emerging opportunities for CVA. These discussions provide us with an understanding on how CVA is currently being measured, where CVA fits into their systems, and how CVA practices are expected to evolve.

Key findings

- Most institutions are pricing CVA into trades at deal time. Institutions are investing heavily to enhance their counterparty risk system capabilities to calculate real-time incremental CVAs so that risk reducing trades can be priced more aggressively than risk increasing trades. Much of the push for incremental CVA comes from the front office, with traders concerned that the inability to properly assess CVA on a real-time basis is resulting in lost business due to the use of simple, and therefore necessarily conservative, CVA charges.
- Collateral requirements are being tightened and most institutions see the ability to handle collateral more effectively in CVA calculations as key to future success.

- Being able to capture all products, in particular exotics, within a counterparty risk system is a high priority.
- Understanding and managing wrong-way risks are increasingly emphasized in the face of credit derivatives and the failure of monoline insurers.
- Many institutions are pricing counterparty risk based on their own default (DVA), and are examining the best way to manage this component.

A history of counterparty credit risk

In 2007,we started to experience what became the worst financial crisis since the 1930s. It grew to touch the global stage from its origins in the United States. It also spread rapidly from the financial markets to have a significant impact on the general economy. The new millennium has been disastrous for derivatives and financial risk management. Some financial institutions have declined or failed, such as the high profile bankruptcy of Lehman Brothers; and even more would have folded were it not for government aid. To address today's considerable financial challenges, a sector that needs particular and urgent attention is that of counterparty credit risk (CCR).

CCR covers loans and repo transactions and, most importantly, the enormous volume of over-the-counter (OTC) derivatives. Over time, derivatives risk fluctuates from an asset to a liability position, exposing both of the parties involved to the related exposure and CCR. In this context of change, and given the growth of the OTC derivatives market (*Figure 1*) in the last decade, it is surprising that methods for quantifying CCR have not attracted more widespread attention like value-at-risk (VAR) has attracted for quantifying market risks. It is likely that numerous factors account for this situation, however, a key element may well be that the size and scale of CCR has resulted in its obscurity: invisible on account of its excessive self-evidence.

In the early days of the derivatives markets, there was a tendency to deal only with the most credit-worthy institutions. Less worthy counterparties were either excluded entirely, or were presented with additional trading requirements, such as paying substantial premiums or agreeing to tight collateral terms. The result was that financial institutions set up triple-A rated bankruptcy-remote subsidiaries to handle their derivatives operations, and monoline insurers took massive one-way risks based on the flawed notion that their triple-A credit quality immunized those trading with them against CCR, even in the absence of commonly used collateral agreements. The credit crisis has brought CCR to prominence now that the attitude of "too big to fail" is dispelled and CCR is now considered by many to be the key financial risk.

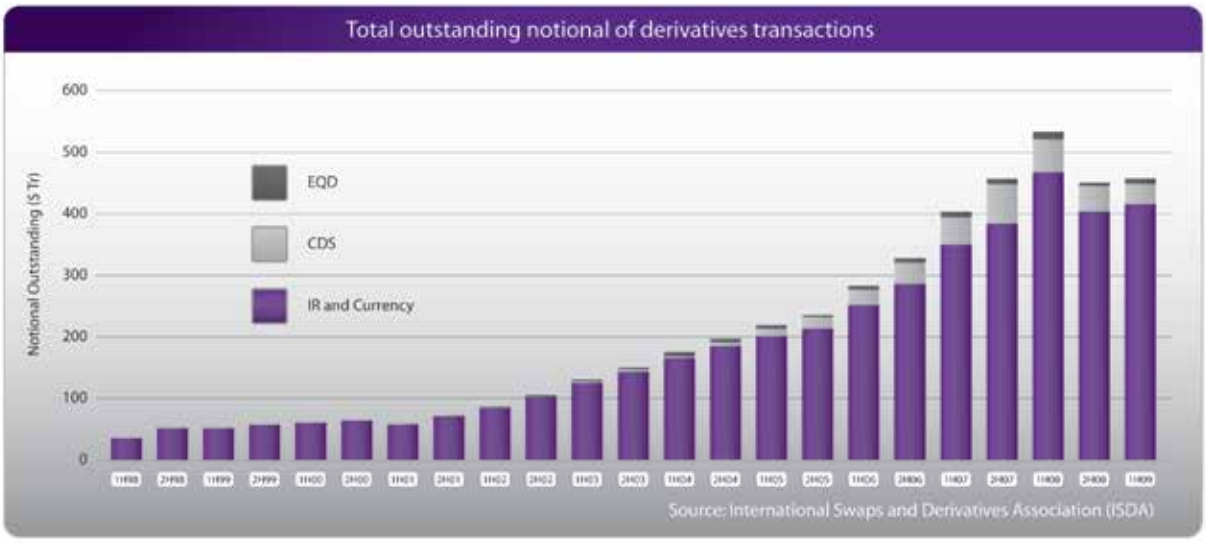


Figure 1: Total outstanding notional (in trillions of U.S.dollars) covering interest rate, currency products, credit default swaps (from 2001 onwards) and equity derivatives (from 2002 onwards)

A driving factor in the growth of the OTC derivatives market has been the ability to apply the netting of transactions to a defaulted counterparty. This dramatically reduces exposure since an institution may offset positive and negative positions with respect to an individual counterparty, should the correct netting agreements be in place. While netting is a very useful risk mitigant, it significantly complicates quantitative measurements, as shown later.

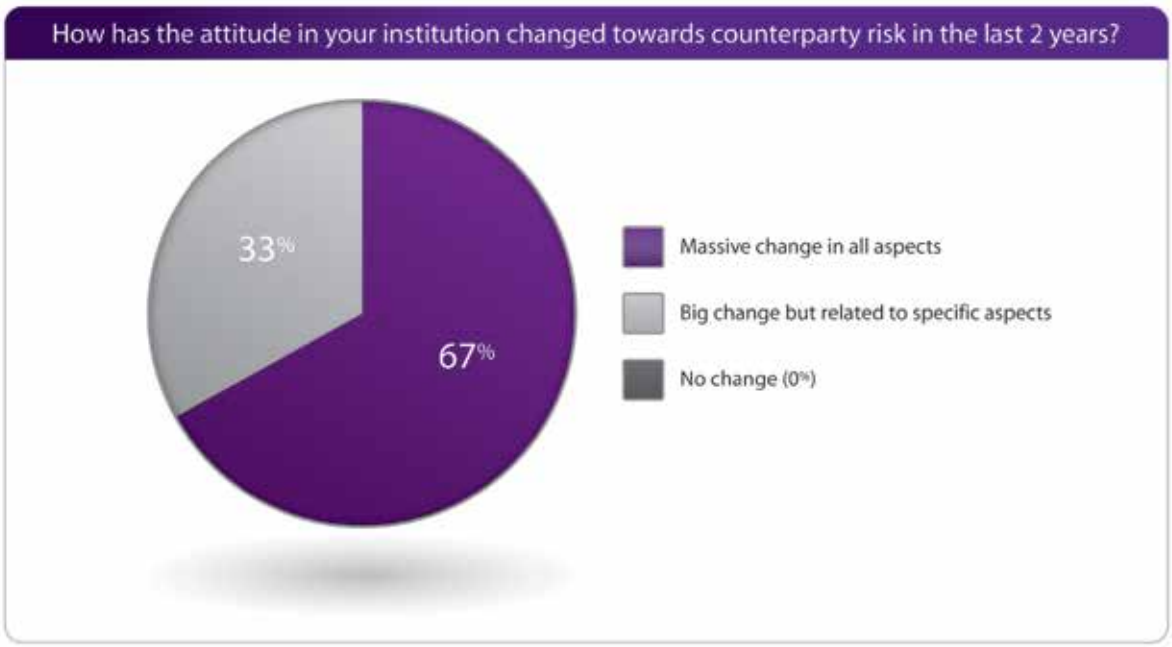
A study that stands on the results of a focused survey

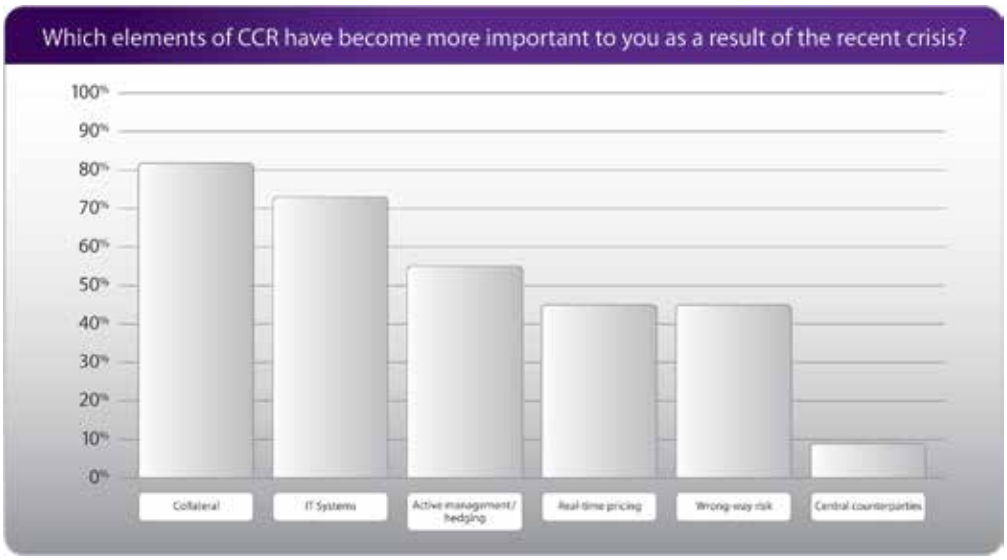
We surveyed and interviewed a cross-section of financial institutions facing significant CCR, with the majority of responses provided by banks. The confidential survey explored topics on counterparty risk practices, pricing, hedging and IT systems. A breakdown of the most pertinent responses is detailed throughout this document.

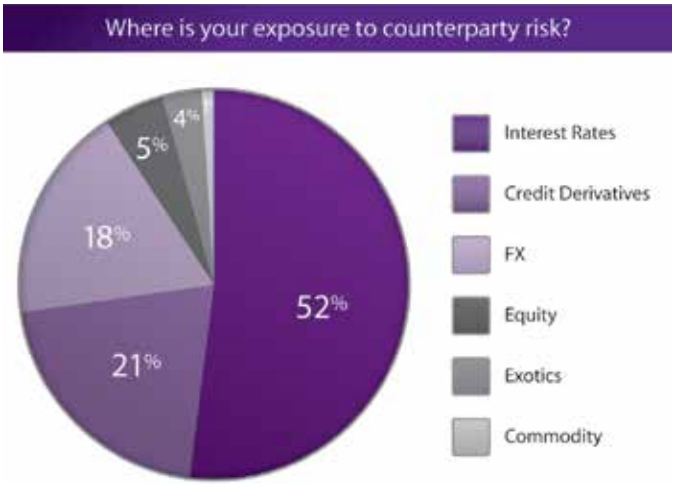
Counterparty risk and the credit crisis

All market participants have noted significant changes related to the way they approach CCR. Many financial institutions had previously under-emphasized CCR since the majority of their derivatives exposure was with "too big to fail" counterparties. Other institutions relied on credit lines to provide a means to prevent exposure to any single counterparty becoming excessive, but did not actively price or manage the underlying risk. Some financial institutions used credit value adjustment (CVA) to appropriately price the CCRs in their derivatives books, but without recognition of their own potential default.

Institutions are changing their approach to counterparty credit risk, and are pursuing opportunities across several areas such as: the improved measurement and control of CCR, the implementation of CVA programs, and the recognition of one's own default probability. There has been a corresponding tightening up of traditional risk mitigation methods within collateral management (margining), and an increase in hedging. Counterparty credit risk has rapidly become the problem of all financial institutions, big or small. The rapid growth in the OTC derivatives market has been reversed, at least temporarily, which emphasizes the need for better CCR management, as this will allow trading activity to increase while reducing the chance of significant future losses or systemically driven market disturbances.







Recognizing the source of CCR is a first step in controlling risk in the changing environment. The notional outstanding value within the OTC derivatives market by asset class (*Figure 2*) is only a first clue as to where CCR resides. Though most institutions cite interest rate products as contributing the most to their overall risk, foreign exchange (FX) and credit derivatives are normally given far greater significance than their notional value might suggest. This is not surprising when considering the long-dated nature and notional exchange in many FX products, as well as the significant wrong-way risks inherent in credit derivatives transactions. While some institutions have little or no exposure of this kind, assessing the risk of exotic derivatives within an integrated counterparty risk framework is important for those active in exotic products.

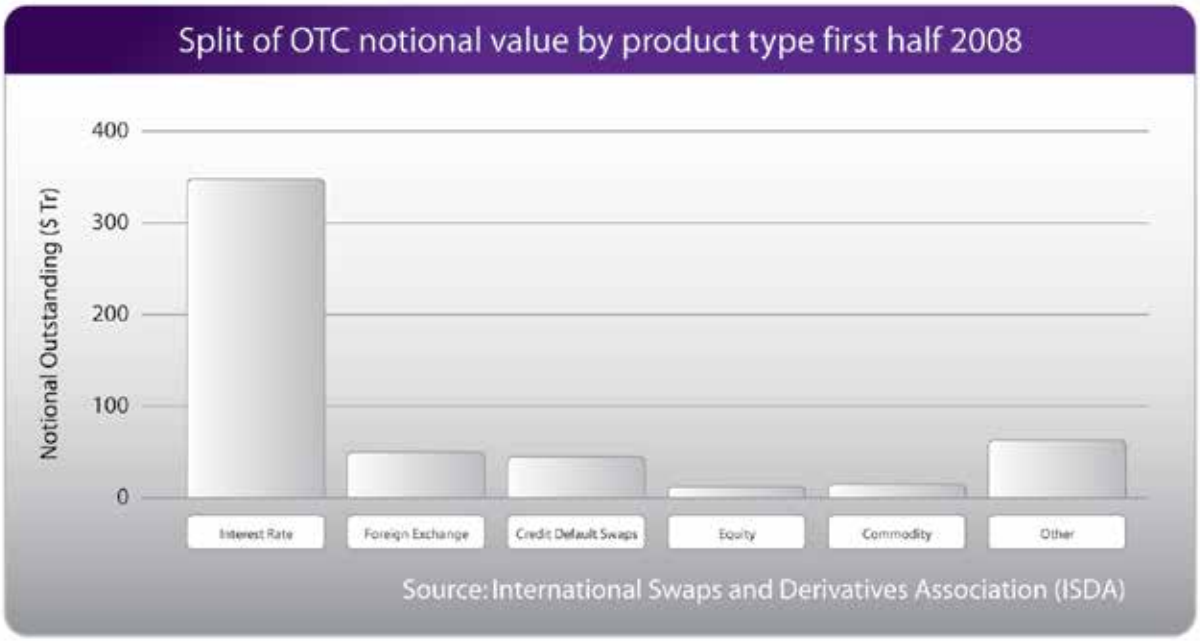


Figure 2: Split of OTC notional value by product type as of first half 2008.

The dynamics of credit value adjustment

Financial institutions have traditionally controlled CCR by setting limits against future exposures and verifying potential trades against these limits. Such a practice is consistent with portfolio diversification and generally permits trades that moderately reduce or increase exposure, but this traditional approach risks rejecting trading opportunities with large exposures that exceed set limits. Using CVA grants enterprises the additional benefit of representing CCR as a dynamic quantity and pricing it directly with new transactions, in association with future losses, and in relation to existing positions.

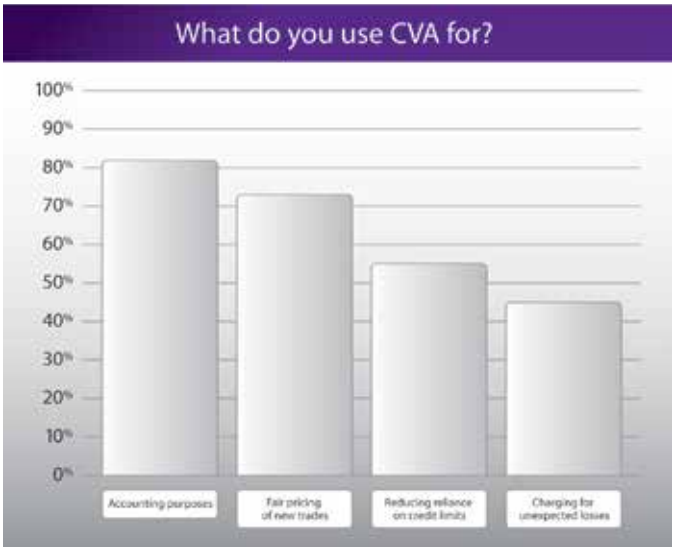
The following areas are driving business interest in CVA:

Accounting rules

Accurate pricing of CCR requires associating a value to the risk of all outstanding positions with a given counterparty. This is increasingly recognized as a key element in the accurate reporting of earnings. Accounting standards now require an appropriate mark-to-market adjustment of derivatives positions that include the possibility of future defaults. For example, Financial Accounting Statement (FAS) 157 sets guidelines for how enterprises must report market or fair values, and requires companies to adopt a more accurate view of portfolios by considering expected losses associated with counterparty defaults. For these reasons, new accounting rules and standards are key motivators for most institutions to transition from passive to active CCR management.

Fair pricing of new business

Firms that adopt CVA gain a metric to measure trading desk performance, and can use CVA to create incentives for individuals and departments to choose the most appropriate trades. In many cases where the CVA measure has been implemented effectively, individuals and departments are charged for their impact to overall exposure, and the charged funds are allocated to hedge against CCR and absorb potential future default losses. For years, this had been exclusively practiced by the largest derivatives professionals; it is now increasingly common for all banks to charge individual trading desks for the counterparty credit risk exposure incurred on a trade-by-trade basis.

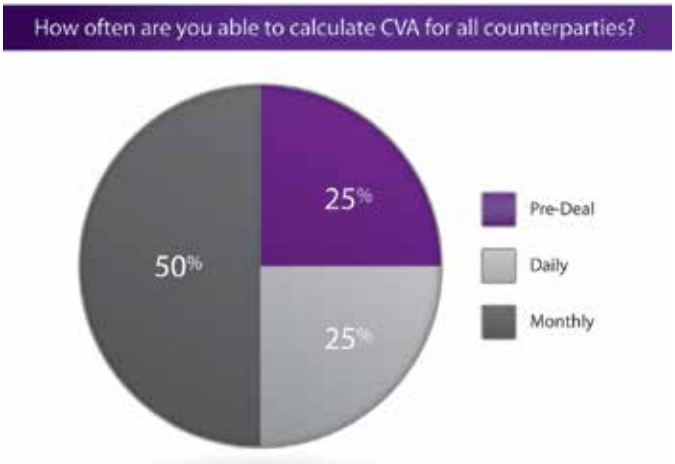


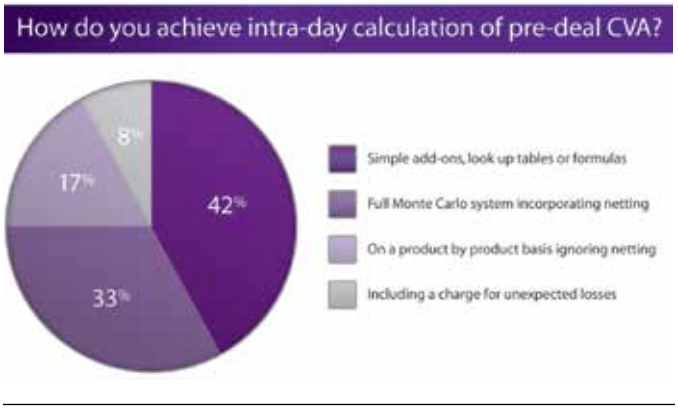
Calculating credit value adjustment

CVA is traditionally defined as the difference between the risk-free and risky value of one or more trades, or the expected loss arising from a future counterparty default. It can be formulated as[1]:

CVA ≅ Discounted expected exposure **x** Default probability **x** Loss given default

The exposure components required for CVA are often readily available from exposure management systems, although institutions often re-simulate this under a so-called risk-neutral measure. Default probabilities and loss given defaults may be obtained via market credit spreads and historical data. The non-linearity with respect to a netting set means that computing the CVA of a new trade requires equivalent calculations be applied to the existing trades within the netting set[2]. Therefore, the charge for a new transaction should ideally be the incremental CVA, which accounts for existing transactions with the same counterparty and may be netted. Note that incremental CVA will always[3] be less than the stand-alone CVA and may be negative, indicating a reduction of CCR, similar to the practice of an unwind via a mirror trade which reverses a transaction through another offsetting transaction in the market.





Some institutions have the ability to compute CVA on a daily and even intra-daily basis for pre-deal pricing by using a Monte Carlo simulation that accounts for netting effects. However, a significant number of survey participants rely on simpler approaches for pre-deal pricing such as add-ons and look-up tables, and therefore compute full CVA only periodically in order to meet accountings responsibilities. Virtually all institutions strongly value the ability to compute incremental CVA on an intra-day basis for all transaction types. Much of the push for incremental CVA comes from the front office, with traders concerned that the inability to properly assess CCR on a real-time basis is losing them business due to the use of simple, and therefore necessarily conservative, CVA charges.

Components for a successful CVA system

Scenario generation

Scenarios are generated on risk factors, economic variables whose value or change in value may result in a change in the value of a portfolio. Risk factors can be directly observable, for example equity prices, or can be implied from market conditions, for example zero curves and volatility surfaces. At any point in time, the value of a collection of risk factors completely determines the mark-to-market value of a portfolio. Scenario generation must cover a complete range of market variables including interest rates, foreign exchange rates, credit spreads, volatilities, equity and commodity prices. Generally credit exposure calculations use scenarios that are derived from historical risk factor data. CVA calculations, on the other hand, use risk neutral scenarios that are calibrated to current market conditions.

Pricing and valuation

After generating a large number of scenarios, it is necessary to revaluate every single product in each scenario. Given the enormous scale of pricings, even those products that are commonly fast at valuation can come under stress. This speed of this process can be significantly increased up by applying both financial and computational optimizations. Institutions seem to spend disproportionate amounts of time on the accurate treatment of exotics, though it could be argued that they are attempting to refine valuations far beyond the error margins of the underlying variables being simulated, especially in the case of long time horizons.

Aggregation and post trade processing

This component includes the post processing of exposure to adjust for collateral, the aggregation of raw exposure simulations into netting sets, and the calculation of exposure metrics required for CVA calculations.

Databases

Substantial data must be collected from various front and back office systems, as well as external sources. The coordination of multiple departments for the efficient retrieval of stored data is crucial and has often been a significant bottleneck for firms implementing a complex credit risk management system. Rapid data retrieval is extremely important. Data requirements cover the following aspects:

- Market data
- Legal entities
- Other legal information
- Default probabilities and recovery rates
- Trade details
- Collateral agreements
- Credit lines (limits)

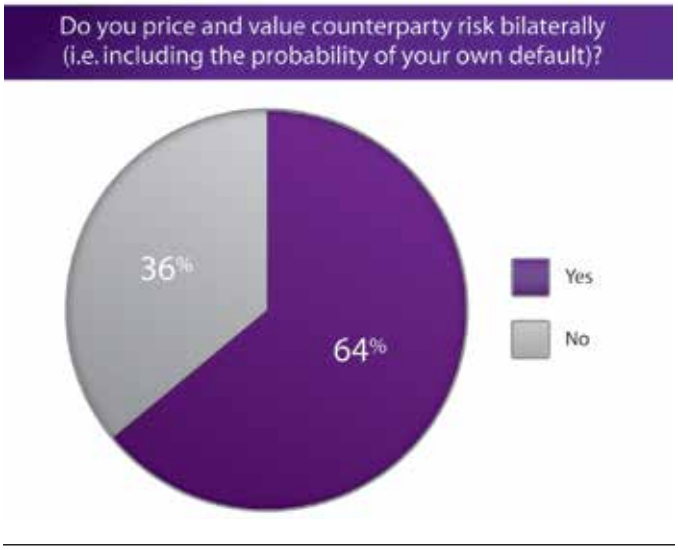
The end of credit lines?

CVA can be applied at the netting set level to account for expected losses. However, an institution should additionally consider unexpected losses, such as alignments to economic capital calculations. Unexpected losses do not simply sum over counterparties and this creates an extra layer of complexity. Unexpected losses must be calculated using simulations that consider the uncertainty in both the realization of counterparty defaults and the resulting exposures to defaulted counterparties.

Even institutions with advanced CVA systems still rely on credit lines to control exposure. This is perhaps recognition of the CVA as only an expected loss-based measure. A fraction of institutions state that they do have the ability to recognize the impact of new trades on unexpected losses; however, there does not appear to be a strong appetite for systems computing incremental unexpected losses at the portfolio level, despite grid-based solutions that make this feasible. It would seem that most consider it enough of a challenge to maintain a fully functional system at the netting set level that incorporates all effects, such as netting, collateral and wrong-way risk.

Can you profit now from your own future default?

A trend that has become increasingly relevant and popular for the large derivatives dealers, especially since 2007, has been to consider the bilateral nature of CCR. This means that an institution would calculate a CVA under the assumption that they, as well as their counterparty, may default. A defaulting institution "gains" on any outstanding liabilities that cannot be paid in full. This component is often referred to as debt value adjustment (DVA). DVA is gaining common acceptance among those surveyed, and it is supported under accountancy regulations. Most institutions view bilateral considerations as important in order to agree on new transactions, unwinds and to minimize CVA volatility. However, many market participants agree that the concept of pricing future gains from the possibility of their own default seems unnatural and antithetic to the spirit of CVA. Indeed, institutions actively using DVA are struggling with the manner in which this can be monetized (see hedging section).



How to manage CVA

Most large users of derivatives either already have CVA groups dedicated to controlling CCR for their business lines, or they are quickly developing such groups. It is natural to centralize the management of CVA since a typical counterparty can be linked across numerous business areas and trading desks. CVA desks can charge all risk takers consistently for the incremental risks they add and are therefore able to manage the overall volatility of CVA within the institution. Establishing such a specialized group can add enormous value to an institution's ability to manage risk. Not only can they improve the competitive advantage within transactions, but, just as importantly, they can realize when it is best to walk away from a transaction with another counterparty. CVA desks can also increase the level of business with a reliable counterparty, and reduce concentration risk by diversifying credit exposure. These specialized CVA groups, similar to front-office trading desks, are increasingly seen as being well positioned for such management. However, some institutions manage CVA with risk management teams, while others have no single dedicated group for managing CCR.

Wrong-way risk

Wrong-way risk is the phrase generally used to indicate an unfavorable correlation between exposure and counterparty credit quality (i.e. the exposure is high when the counterparty is more likely to default and vice versa). Right-way risk represents the opposite, although, wrong-way risk is more frequently observed, as a result of speculation, failed hedges and credit derivatives. While many derivatives transactions can be considered to have little or no wrong-way risk, its manifestation can be rather subtle and cause a substantial or even catastrophic increase in CCR.

Wrong-way risk is often difficult to define. For example, general empirical evidence supports a clustering of U.S. corporate defaults during periods of falling interest rates. On the other hand, a highly leveraged institution might be more likely to default in a high interest-rate environment. Wrong-way risk should be rather rare given the appropriate application of financial instruments. If users of derivatives are hedging then they should generate right-way risk. Again, there can be subtleties in the assumption of right over wrong-way risk. Suppose an institution is asked by an airline to enter into an oil receiver swap to hedge their exposure to rising oil prices. The institution will have an exposure when the price of oil is low, but at this point, the airline's cashflows are benefiting due to reduced fuel costs. When the price of oil is high then the airline may be in a weaker financial situation but there will be no exposure for the institution.

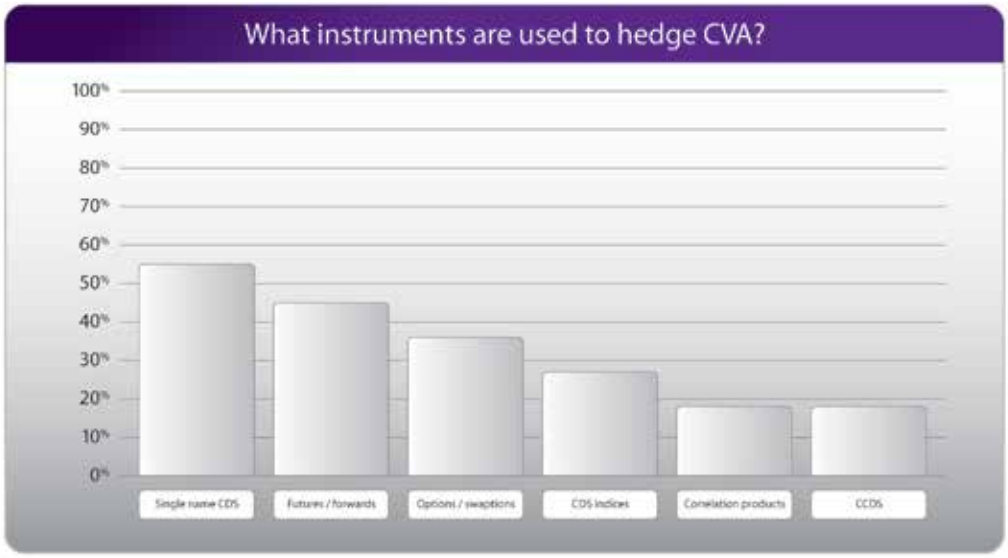
This appears to represent right-way risk. However, if the drop in the price of oil is more severe than expected, then there is wrong-way risk, since the low oil costs are unlikely to solve the airline's loss of revenue from dramatically falling seat sales.

Long protection credit derivative trades are inherently wrong-way risk products due to the unfavourable relation between the value of the contract (defaults of a reference entity or portfolio) and the counterparty default. This has created significant problems within the credit derivatives marketplace, and reached a peak with the billions of dollars of write-downs experienced by banks trading with monoline insurers. Effectively, such write-downs resulted from CVA losses due to the dramatic deterioration in the triple-A monolines' credit quality that was left unhedged. Few banks properly accounted for and managed the CVA when trading with monoline insurers.

Most institutions make rough assessments of the wrong-way risk of transactions, either within a CVA system using alternative, more conservative, exposure metrics or external to any systems. The integration of wrong-way risks within a CVA framework is now considered critical, although most institutions are looking at simple and pragmatic ways of doing this given the complexities they already face. Observing the recent difficulties faced by monoline insurers has also taught institutions that qualitative assessment and scenario analysis are effective tools to properly account and control wrong-way risk, especially when compared with simple models.

Hedging CVA

Since CVA is presented as a price for CCR, it is natural to ask what the associated "hedge" is. There are many ways to control CCR. Without the ability to hedge, enterprises may find themselves severely limited in the type and amount of transactions they can take and the counterparties with which they can trade. Furthermore, an institution's total CVA may exhibit severe volatility and, therefore, potentially lead to large losses. Hedging CCR poses many challenges due to the number of market variables involved and the linkages between them.

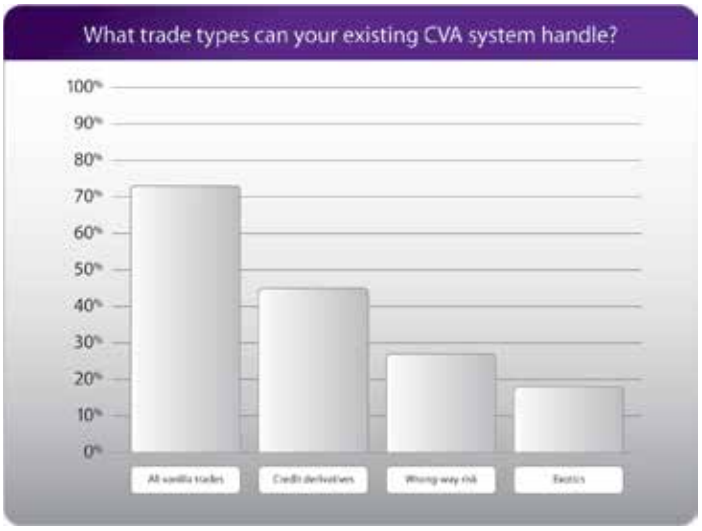


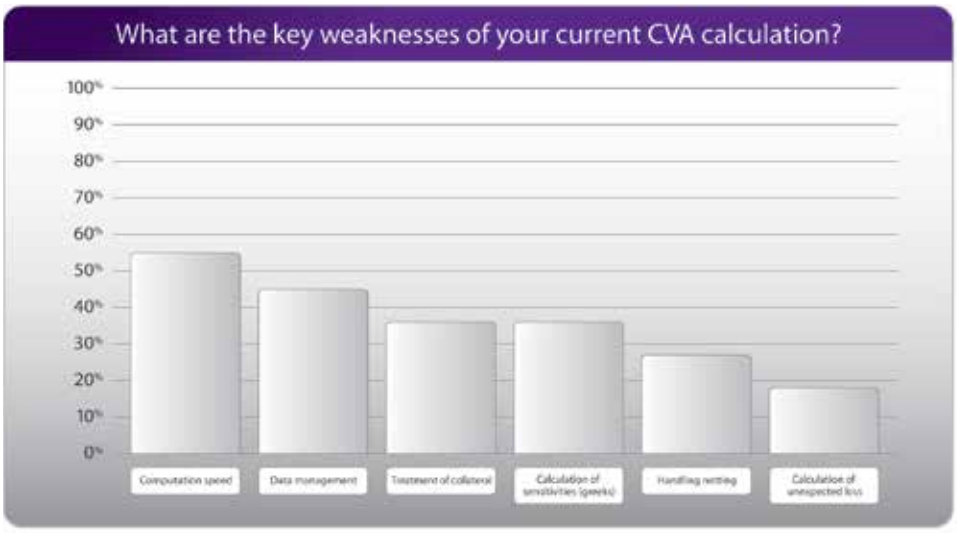
Hedging the market risk exposure component of CVA is more straightforward, due to the underlying liquidity and offset of sensitivities across counterparties. However, hedging the credit component is more problematic, since the credit default swap (CDS) and contingent CDS (CCDS) markets are far from liquid enough to allow complete protection. Ultimately, credit hedges are far from perfect and since single name protection is often unavailable, the majority of hedging is with respect to an index.

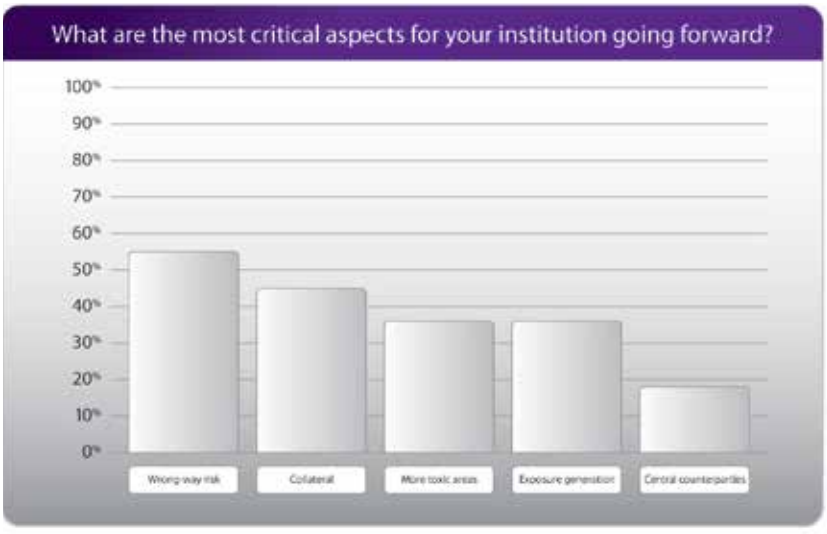
Many institutions derive default probabilities by mapping credit ratings to "market" credit spread curves via indices, so it is expected to hedge with these same indices to avoid severe CVA volatility. So-called cross-gamma terms, especially in the case of wrong-way risk, create additional difficulties and are almost exclusively unhedged.

Though it may seem contrary, financial institutions have been motivated to seriously look at hedging their own default probability as a result of the recent experiences of banks in August 2009, after improvements in their credit "quality.*" Hedging of the DVA component has been sometimes achieved indirectly by selling CDS protection on highly correlated institutions. However, the inability to hedge CCR at the single name level actually helps recognition of DVA since an institution can aim to find an aggregate credit hedge that accounts for default of both their counterparty and themselves. A key line of research is the ability to calculate "betas" with respect to one's own credit spread as well as for all counterparties. These betas allow aggregate hedges to be constructed from various credit indices. An institution will need to buy protection against every counterparty (positive beta) and sell protection on itself (negative beta). Aggregating an enterprise's own default into the hedge ratio provides a means of realizing DVA while ignoring idiosyncratic events. In order to hedge the CCR book, an institution with a wider than average credit spread is typically a net seller of CDS protection. This might be considered as one of the many counter-intuitive aspects of DVA.

* CDS premiums referencing banks narrowed compared to the rest of the market.


What trade types can your existing CVA system handle?
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
All vanilla trades
Credit derivatives
Wrong way risk
Exotics


What are the key weaknesses of your current CVA calculation?
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Computation speed
Data management
Treatment of collateral
Calculation of sensitivities (greeks)
Handling netting
Calculation of unexpected loss


What are the most critical aspects for your institution going forward?
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Wrong way risk
Collateral
More toxic areas
Exposure generation
Central counterparties

Systems requirements

It is important to understand where CVA resides within the systems of an institution. Trading systems cannot easily be extended since the calculation of CVA is often an order of magnitude more complex than that of the underlying product, such as in the case of interest rate swaps from a yield curve. It is possible to assemble approximate CVA systems by linking individual IT components. However, there is a growing interest in more comprehensive enterprise-wide solutions that cover all relevant transactions in real-time. The ability to calculate incremental CVA and risk sensitivities in real time has gained prominence because of the advantages realized by quantifying CVA before a deal is made. In fact, the CVA is often a primary determinant of whether or not a deal goes through, especially for vanilla trades with well-defined prices and tight bid-offer spreads. Furthermore, the ability to perform stress tests, scenario analysis, and to include the treatment of CVA in electronic trading transactions, affords even more benefits. Most institutions agree that maximizing on opportunities for CVA requires a sophisticated and highly flexible infrastructure. As new risks emerge, so will opportunities, and successful institutions will be those able to respond quickly to the incorporation of new asset classes, business lines, and credit mitigation techniques.

The future of counterparty risk

Firms that are facing issues of counterparty credit risk have many options available to manage their overall exposure, and the key to remaining competitive in a changing environment is intelligent planning and decision-making at all levels. In the short term, an increasing number of financial institutions are taking steps to tighten collateral management parameters in an effort to reduce exposure and increase profitability. Firms that recognize the benefits of pricing CVA into trades at deal time are making the major investments required to enhance their existing CCR systems or to design new ones. The aim is to develop capabilities such as incremental calculations of CVA, real-time computations, the incorporation of right/wrong way risk, and the expansion of product coverage to include all trade types including exotics. In the coming years, the implementation of in-house and third party CVA systems will clearly be a key objective for banks and other financial institutions.

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1 The actual CVA involves an integration of this expression over time although this is not significantly more difficult. Note that this expression ignores the presence of wrong-way risks discussed later.

2 A netting set will either cover all or a subset of the transactions with a given counterparty. If there exists more than one netting set with a given counterparty then the CVA can be considered additive.

3 Except in the case of bilateral or DVA discussed later.

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