Real-Time Credit Valuation Adjustment and Wrong Way Risk

Estimating the most accurate CVA is a significant challenge, requiring that banks take into account real-time information such as credit spreads, macroeconomic factors, commodity prices, political crises, technology and other factors.

Executive Summary

This paper presents a new framework for real-time credit value adjustment (CVA) and wrong way risk (WWR).

In contrast to previous studies, the proposed model herein relies on the probability distribution of a model filter - an optimal estimator that infers parameters of interest from indirect, inaccurate and uncertain observations. New measurements can be processed as they arrive.

Empirical studies indicate that mark-to-market (M2M) values have not been an effective reflection of the true value of an asset. As a consequence, the International Accounting Standard (IAS) 139 requires banks to provide a fair-value adjustment due to counterparty risk. Thus CVA became mandatory in 2000. However, it received little attention until the 2008 financial crisis in which profit and loss (P&L) swings due to CVA changes touched billions of dollars. CVA has now become the first line of defense and the core of counterparty credit risk management.

Before the advent of CVA, the general practice in the industry was to mark derivative portfolios at M2M values. Often, this was evaluated independently of counterparty credit risk. Consider a stock that ends the day at $10. This is the M2M value carried over to accounting/valuation books to reflect daily P&L. However, the stock actually rose intraday from its previous M2M value of $8 to $22 and touched a low of $2 before closing at $10. How can the M2M value then reflect the true value of the stock? Several reasons could be ascertained/cited which would need an altogether different exposition.

To address this issue, recent studies from regulators have suggested that mark-to-model and mark-to-model valuations are more effective.
Previous works on CVA were focused on unilateral CVA that assumes only one counterparty will default. This ignores the fact that counterparty risk can be bilateral and even multilateral. A growing trend is to consider the bilateral nature of counterparty credit risk. However, Hull and White (2012) argue that bilateral CVA is more controversial than unilateral CVA, as the possibility that a dealer might default is, in theory, a benefit to the dealer.

CVA is, by definition, the difference between the risk-free portfolio value and the true portfolio value that takes into account the possibility of a counterparty’s default. The risk-free portfolio value is what brokers quote and trading systems or models normally report. The true portfolio value, however, is a relatively less explored and less transparent area, and is the main challenge for CVA.

CVA not only allows institutions to move beyond the traditional control mindset of credit risk limits and to quantify counterparty risk as a single measurable P&L number, but also offers an opportunity for banks to dynamically manage, price and hedge counterparty risk. The benefits of CVA are widely acknowledged. Many banks have set up internal credit risk trading desks to manage counterparty risk on derivative transactions.

In general, risk valuation can be classified into two categories: the default time approach (DTA) and the default probability approach (DPA). DTA involves the default time explicitly. Most CVA models (Brigo and Capponi (2008), Lipton and Sepp (2009), Pykhtin and Zhu (2007), Gregory (2009), etc.) are based on this approach.

DTA is very intuitive; it has the disadvantage that it explicitly involves the default time. We are very unlikely to have complete information about a firm’s default point. Valuation under the DTA is performed via Monte Carlo simulation.

DPA, on the other hand, relies on the probability distribution of the default time rather than the default time itself. Sometimes the DPA yields simple closed form solutions.

Wrong way risk (WWR) occurs when exposure to a counterparty is adversely correlated with the credit quality of that counterparty, while right way risk occurs when exposure to a counterparty is positively correlated with the credit quality of that counterparty. In WWR, exposure tends to increase when counterparty credit quality worsens, while in right way risk exposure tends to decrease.

Changing trends in CVA and WWR: CVA valuation methodologies have undergone a sea change over the past few years. Overnight index swap (OIS) discounting, collateral optimization and funding are the new focus areas. Collateral valuation is giving way to collateral modelling and an increased emphasis on quantifying WWR. Back-testing frameworks establishing model validation procedures are being explored apart from central clearing (CCP) quantifying trades and default fund exposures in calculating associated capital charges.

The use of risk-neutral default probabilities via credit spreads is becoming standard practice in the quantification of CVA, driven by accounting and capital rules.

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The general shift to OIS discounting as the best standard valuation method (collateralized trades) has gained industry traction and acceptance given the choice of acceptable currencies. CSA and the inherent value has given way to options for optimizing it. FVA as a material component in valuation and the consequences of DVA overlap will also create variations in approaches across markets.

This paper proposes an alternative approach to finding the most accurate CVA estimate from available data.

Current Practice
CVA is expected loss due to counterparty default at any time before portfolio maturity (M2M) P&L. It uses four components to manage risk:

- **Portfolio**: Depends on the entire portfolio of trades with the counterparty (valuation or true value of an asset/exposure).
- **Collateral**: Depends on the nature of collateral posted or received by the counterparty and
CSA details (collateral optimization, valuation and real-time reconciliation).

- **Asset class complexity**: Cannot be easily valued or hedged (the homogeneity and complexity of exotic trades in the portfolio, the stochastic nature of valuation).
- **Risk management**: Causes fundamental changes in how trading business is organized (e.g., CVA desk).

We believe that more than 83% of a bank’s portfolio value stems from interest rate swaps and forward contracts and cross-currency swaps, and to a lesser extent credit derivatives and exotics.

From a CVA estimation perspective, we are keen to forecast the actual value of the loss due to counterparty default at any time before portfolio maturity. Once this has been estimated, checks at a defined horizon should gauge whether estimated charges are in line with realized values (losses). This could be in the form of MTM or realized P&L. Should a large variance occur, it would be apparent that the filtration process did not factor in discrete or unknown variables, or ignored them. This leads to the next fundamental question: How does one estimate counterparty default, and based on what variables? More importantly, how does one estimate CVA taking into account real-time information such as correlation, credit spreads, macroeconomic factors, commodity prices, political crisis, technology, etc.?

**CVA: Trading Desk, Asset Class and Products (Exposure)**

For most if not all asset classes, risk analysis must take place as close to real time as possible. Portfolio stratification therefore becomes even more important. The purpose of stratification is portfolio risk analysis - determining the risk associated with each group of assets in a portfolio. The best way to do this is to segment the portfolio into groups of assets with similar characteristics. The basic stratification always includes interest rate, asset type and investor type, among other factors.

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The overall CVA is driven by several factors such as large notional amounts, long dated trades and overall complexity (with credit derivatives in particular). Another important component of CVA valuation is collateral and its valuation and quality. Given that the Basel III margin period of risk (MPR), also known as the liquidation period, can be material and much longer than the contractual collateral call frequency (CSA annexure), collateral is widely used as a factor to determine CVA.

**CVA Desk**

Most banks categorize their CVA desk as either a hedge desk (risk mitigation) or a profit center (risk appetite). Though each desk has the potential for a windfall, the complacency around repricing CVA can have disastrous consequences in the wake of a sudden market movement. To mitigate this risk, many banks resort to reallocation. However, in the absence of information of the true value or profitability of the trade dependent on the CVA, this can lead to incorrect pricing. Several firms that have qualified for the IMM approach (by virtue of having demonstrated that non-IMM-qualified trades are calculated as per supervisory standards) have realized that data to run simulations such as Monte Carlo are inadequate and have had to ask regulatory agencies that the current exposure methodology (CEM) model be used for such asset classes/exposures.

Normally, collateral is first ascribed to IMM trades and the residue value is then allocated to CEM trades. This is an erroneous approach since a large portion of the CEM trades are now classified as non-collateral CVA, requiring a different set of calculations.

Second, from a regulatory perspective, firms might be Basel III or report compliant (CVA reports, RWA, capital charges, etc.), but when adverse market movements cascade down to individual trades (part of the portfolio), the exposures tend to go haywire and the lack of liquidity adds to the misery as witnessed in the recent crisis.

**Proposed Solution**

The building blocks to create a real-time CVA pricing mechanism should factor in multiple scenarios or market “noise,” thus enabling CVA repricing to reflect micro-changes in exposures. This means assigning counterparty default values so as to enable effective netting or utilizing credit lines to offset or hedge default risk.

We propose the following guidelines for creating a robust tool for real-time credit risk valuation.
A Typical CVA Landscape

**DATA SOURCES**
- CSA Annexure/ISDA Agmts
- Credit Lines
- Trade Details: Collateral
- Limits & Thresholds: Trading Desk

**ETL**
- Expected Exposure (IMM Model)
- Expected Exposure - CEM Trades
- Trade Positions (Portfolio Level)
- Counterparty Data, Rating
- Market Reference Data
- Hedge Trades (Single Name/Index)
- Finance Reporting Level Information
- LGD/PD/Recovery Rate

**TRADE SCOPING**
- Identify Models for CVA (STD/Advanced)
- Assign Guarantors
- Assign Hedge Books to Trades
- Identify and Exclude Internal Trades. Define IMM Risk Tenor
- Assign System Parameters
- Define Bucketing for Proxy Spreads

**STAGING**
- Data Enrichment & Intermediary Risk Factors Calculation (Batch Processing)
  - Calculate Credit Spreads for Liquid Names (Advanced CVA)
  - Calculate Reg CS01 (Credit Spread Sensitivities) for Liquid Names
  - Calculate Proxy Spreads for Illiquid Names
  - Bucketing Based on Region, Industry & Rating
  - Bootstrapping to Generate Proxy Spreads for All 65 IMM Tenors

**CORE CALCULATION**
- Calculate Default Grade (DG) for Trades
- Calculate Single Name Hedge Notional & CS01
- Calculate Index Hedge Notional & CS01
- Identify Agency Trades

**P&L AND VAR CALCULATIONS**
- Calculate Portfolio PSI Based on Historical Simulation Mtm (520 Days Recent Data)
- Calculate Portfolio Stressed P&L Based on Historical Simulation Mtm (260 Days 2008-2009 Stressed Period)
- Calculate 95% 1 Day VaR
- Calculate 99% 1 Day VaR
- Calculate Proxy Add-on
- Calculate Curve Risk Add-on
- Calculate Index Skew Add-on
- Calculate Advanced CVA Using Internal Model
- Calculate Advanced CVA Using Full Revaluation Approach
- Calculate Implied Volatility
- Assign Credit Ratings to Non-IMM Trades
- Calculate Portfolio Risk Weight
- Calculate Standardized CVA for Non-IMM trades (Standard Regulatory Model)

**RISK AGGREGATION**
- Add Overall CVA Change Based on Reporting Scope
- Calculate RWA BASED ON Reporting Scope

**REGULATORY REPORTS**
- CVR Reports (T+2)
- What-if Analysis
- Verify RWA Aggregation Level
- Customized Reports

Figure 1
We propose a hybrid solution that combines a host of available approaches not restricted to the capital markets or actuarial science arena, including a bio-informatica model. For model validation and “best fit” in terms of “noise,” we suggest a champion-challenger model as well. We address WWR towards the end.

**Note:** CCP clearing issues are not addressed in this paper.

Margin period of risk (MPR), also known as the “liquidation period,” stands for the time period from the most recent exchange of collateral covering a netting set of financial instruments with a defaulting counterparty until the financial instruments are closed out and the resulting market risk is re-hedged.

**Mark-to-Market**

Mark-to-market, sometimes known as fair value accounting, refers to the accounting standards that determine the value of a position held in a financial instrument based on the current fair market price for the instrument or similar instruments.

IFRS 13 Fair Value Measurement, which is the latest standard within the International Financial Reporting Standards (IFRS) framework dealing with the measurement of fair value, defines fair value as “the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date.” The definition of fair value in U.S. GAAP is consistent. Broadly speaking, fair value can be estimated using either a quoted price in an active market (mark-to-market) or, in the absence of an active market, a valuation technique based on observable market inputs and/or recent market transactions (mark-to-model).

Both U.S. GAAP and IFRS recognize that price quotations in an active market are the best evidence of fair value and must be preferred over other valuation techniques such as mark-to-model methods. This hierarchy is also encouraged within IOSCO’s policy recommendations for MMFs2.

Under normal market operating conditions, mark-to-market reflects the values in actual market transactions between willing buyers and sellers. There is a single price, transparent to all in the market. Mark-to-model has meaning only if the model used reflects the reality of the market. The degree to which the model reflects market value is usually determined by regular stress testing and back testing.

Often, while models are operative over the long term, market factors can cause the model to fail at a specific point for any number of reasons. All models require raw data to calculate a valuation of an asset. This presents many issues that must be addressed by the user of the models.

**Mark-to-Model**

Commercial paper (CP) and certificates of deposit (CDs) are transferable securities but are rarely traded in the secondary market. Due to the short maturity of these types of financial instruments, they have very low sensitivity to movements in market rates and, as such, there is minimal incentive to trade these instruments. Investors will typically hold onto CPs and CDs till maturity.

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Therefore, fair value for these assets must be estimated using a discounted cash flow methodology based on current yield curves. Normal market conditions do not pose any significant difficulties for the mathematical modelling of cash flows. However, market participants might differ on the construction of yield curves for discounting those cash flows.

There are two different approaches that could be employed:

**Money market yield curve:** The simplest approach, and one that is already used by many MMFs, would be to discount the cash flows using money market yield curves. One common approach is to use LIBOR curves (rates for short-term, unsecured interbank borrowing and lending) for the relevant currencies. However, to minimize basis risk (i.e., the risk that the valuation is based on a yield curve that fails to incorporate all components of risk within these instruments) in the valuation of CP and CD, a more accurate approach would be to use composite rate quotes for new CP and CD issuances, typically quoted in the market for top-tier and second-tier issuers in USD, EUR and GBP. While such rate quotes are available from some market data vendors, there
are concerns in the market about the accuracy and the transparency of these composite curves. Additionally, while the use of money market curves captures the effect of industry-level yield changes on asset valuations, it excludes the impact of issuer level, idiosyncratic risk (i.e., the risk of default by a specific issuer).

Mark-to-matrix is a technique used for less actively traded assets, such as emerging market securities, municipal bonds and asset-backed securities (ABS).

**Issuer yield curve**: While composite rate quotes can be obtained for new issuances, observability can be limited in EUR and GBP CP/CD markets. Also, these curves are not sufficiently granular to determine the rate at which a specific issuer will be able to issue new CPs and CDs. Some issuers will pay rates above the industry curve and some will pay lower rates. Therefore, to most accurately determine the fair value of the CPs and CDs from specific issuers, the cash flows should be discounted using issuer-specific yield curves. In the absence of daily, issuer-level money market rate quotes, the construction of issuer yield curves presents some modeling challenges. Any curve construction will suffer from the absence of secondary market quotes at the short end. However, the objective will be to produce issuer yield curves that are responsive to idiosyncratic risks and that produce accurate fair values when the issuer experiences positive or negative market sentiment. Without a secondary market, credit spread data can only be observed in the new issuance market. New issuance can be infrequent, leading to static pricing information at the short end of the issuer curve, making it non-reactive to current market sentiment. Up-to-date pricing data for a specific issuer may be observed in the bond or credit default swap (CDS) market but incorporating this information to produce current issuer CP and CD curves can be difficult as the dynamics of the bond and CP/CD markets are very different.

**Mark-to-Matrix**

This is a technique used for less actively traded assets, such as emerging market securities, municipal bonds and asset-backed securities (ABS). It involves “bootstrapping” – estimating a credit spread of the asset relative to a more actively traded instrument that can be priced easily.

The highlights/steps are as follows, in sequence:

- A hierarchy of forward curves is constructed instead of just one curve. Each curve in the hierarchy corresponds to a collateralization type. For example, the root of the hierarchy typically corresponds to zero credit risk and is used for discounting all cash flows in the calibration instruments. Other collateralization types include LIBOR, etc. However, the trader can arrange the hierarchy any way they like and/or add extra collateralization types (e.g., for non-USD currencies, currency equivalents of USD curves can be added and calibrated against cross-currency swaps). There is no need for a separate “cost of funding” anymore.

- Each forward curve to be constructed is represented as a sequence of linear segments; the time intervals of these segments can be as short as necessary. They do not need to correspond to standard tenors. As a result, once the curves are constructed, they can be used directly, without any interpolation. The linear coefficients of all curves are the N unknowns to be found (technical details have been omitted).

- “Spikes” in LIBOR rates at year turns are automatically corrected.

- Any number (M) of calibration instruments can be put in, providing the equations to be solved. It is possible to have $N > M$ (the usual case), $N = M$ or $N < M$. Virtually all kinds of instruments can be used, and they may have overlapping tenors without any restrictions. For JPY, it is even possible to use both LIBOR- and TIBOR-derived prices at the same time. The spec for each calibration instrument contains explicit references to the collateralization types and the index (e.g., LIBOR/TIBOR) it depends upon.

- As follows from the above setup, the forward curve parameters are to be derived via a constrained optimization procedure. The constraints are market prices, and the cost function of this procedure is user-configurable: it allows the trader to put in their educated guess of the next central bank rate moves, the requirements for curves continuity or (otherwise) jumps, etc.

- It is even possible to use illiquid market instruments. Their prices are not to be matched directly - the degree of illiquidity serves as a measure of tolerance in matching the market prices (higher illiquidity → higher tolerance).
CVA Modelling
Our approach suggests creation or consolidation at two desks, one at the front office level and the other at the risk management level. The front office CVA desk needs to be accurate and extremely fast, given the complexity of analytics, sensitivities and scenarios. On a parallel plane, each of these trades must reconcile with all levels of collateral posted and/or other credit support documents (CSA) agreements, TPA guarantees, etc. Often ignored or infrequently valued are trades of highly rated counterparties. A combination of short dated, collateralized trade along with other larger exposures must be valued and monitored in real time.

Several banks have no convergence of systems and models between front office and risk management, further compounded by the introduction of new functionality - change requests. To “run a thread” through each of the existing functionalities and align these with the “black box” algorithms/formulas is time-consuming and manually driven. In the wake of changes in technology, new trading venues, collateral management and valuation and emerging regulations, many legacy systems have either become obsolete or are unable to match the speed in reporting or generating alerts. Often, this practice of multiple reports from across legacy, bespoke applications runs the risk of duplication. With the advent of cloud computing, several sectors have been completely revolutionized that were once dominated by large and expensive legacy applications. Thus quick management alerts are a prerequisite and a vital tool for effective risk mitigation.

Another area that requires instantaneous data is the ubiquitous risk management and regulatory desk arena. Trade level population should have the same intensity of computation, speed and accuracy irrespective of the perceived risks of the trades. An overwhelming majority of banks rely on Monte Carlo simulation (with path ranges between 1,000-10,000) with varying time steps. We believe that in addition to the MC simulation method it would be prudent to compare the results with that from another filtration methodology that we call the “champion-challenger” model.

We chose the model for its overall simplicity, the complexity of the inputs, good results in practice due to its structure, its convenience for online real-time processing and because it is easy to formulate and implement (measurement equations need not be inverted).

The one-size-fits-all approach might not work for every trade, especially when pricing illiquid instruments. Given the perils of low sophistication and the resultant exposure increasing exponentially and driving CCR, banks need to strike a balance between the levels of complexity their models ought to handle - especially in terms of curve dynamics and volatility.

The final component of inputs to this model would be the correlation factor between and within asset classes and between CVA and WWR. Though firms use the historically-based correlation approach, we think this approach does not factor in certain dormant elements that might seem like a “lone wolf” acting with other noise but might manifest in a totally unpredicted fashion. We propose a model that factors in information as it arrives and determines and deploys a coefficient that not only detects a correlation between asset classes and exposure but also quantifies the extent of the correlation. In other words, the tangibility in numbers helps ascertain the extent to which risk mitigating factors need to be used on existing portfolios. This is in line with our approach of incorporating the default time approach (DTA) as well as the default probability approach (DPA), as explained earlier.

Our approach suggests creation or consolidation at two desks, one at the front office level and the other at the risk management level. The front office CVA desk needs to be accurate and extremely fast, given the complexity of analytics, sensitivities and scenarios.

Collateral and Valuation
Posting of collateral usually involves a choice between eligible assets as mutually agreed upon in the Credit Support Annexure (CSA) agreement, with eligible collateral usually including cash, bonds, shares, gold, etc. “Haircuts” apply to different kinds of collateral. Equivalent cash amount in CSA base currency is computed (by haircuts and currency exchanges) for all posted collateral as per Basel norms.

Margin period of risk (collateral lag), a new feature under Basel III, has been introduced since most financial defaults were triggered by
liquidity. When stressed, a derivatives party can be expected to delay margin payments. Thus the run-up to CVA calculation involves valuation of collateral as well (in case of margin calls breaching a threshold or high correlation between exposure and collateral).

The objective is to address the valuation and real-time reconciliation between collateral and counterparty exposure as a result of the margin call requirements.

Given the human nature of relationships, fostered over a period of time that sometimes spans generations, extended credit lines or illiquid instruments could be pledged and accepted as collateral.

It bears mention here that collateral could consist of several types and these could either fall or rise in value. An example could be a plain vanilla stock that could rise or fall giving rise to margin calls or posting of additional or different collateral. From a collateral optimization perspective, it can work in two ways:

• From a bank perspective that receives collateral, it is protected from any rise in counterparty exposure. The bank in turn can sell this collateral in case thresholds are breached or the counterparty fails in its commitment to make variation margin payments.

• The same would be the case when the bank’s collateral remains with its counterparty. Any rise in collateral value posted with the counterparty cannot be used by the bank, thus reducing its ability to make good on collateral value which otherwise would have been in the bank’s books.

Another important point is the type and kind of collateral that counterparties could pledge. Given the human nature of relationships, fostered over a period of time that sometimes spans generations, extended credit lines or illiquid instruments could be pledged and accepted as collateral. In recent times, art and relics also have been presented as collateral. In the light of such exotic collateral, valuations could be incorrect, overstated or sentimental in nature, thereby making the task of monitoring and valuing such collateral risky and time-dependent.

We propose a framework that can be used to compare different methods for calculating haircuts and selecting an appropriate method for low-probability events (e.g., large, unexpected declines in asset prices) and one that takes into account the cost of pledging collateral.

Two components are needed to calculate a haircut for collateral:

• The first is a model of the distribution of losses (i.e., frequency with which the asset declines in value), since the distribution of returns is unknown.

• The second is a risk measure, which can be thought of as a way of mapping the loss distribution into a single number (the haircut). There are several ways to model the loss distribution for collateral based on historical data for returns. These include:

  > **Parametric approaches** that use historical data to obtain the parameters necessary to characterize a given distribution (e.g., normal, t, etc.). These parameters are then used to approximate the return distribution, and the haircut is obtained from the resulting quantile given a particular distribution and a confidence level.

  > **Non-parametric approaches**, such as historical-simulation techniques that do not model the return distribution under some explicit parametric model, but instead use the empirical distribution of the data to estimate the quantiles for a given confidence level.

Along with choosing one of the above approaches, the estimation of haircuts requires a means of quantifying risk: a risk measure. Various risk measures can be used. One of the most common is the value at risk (VaR). An additional/alternate risk measure called expected shortfall (ES) has been introduced in Basel III.

To estimate the haircut for such an asset, we use a parametric approach (e.g., a normal return distribution) and select a risk measure (e.g., VaR). Knowing that the asset has a daily percentage change in price with a mean of zero and a standard deviation of x%, we estimate the corresponding normal distribution. Next, we choose a confidence level for the haircut (e.g., 0.5%) and then select a holding period (e.g., one day). Finally, we calculate the corresponding VaR obtained from a normal distribution with the mean and standard deviation of the data and assign this value as the haircut. This parametric approach, combined with VaR, yields a haircut (quantile of the distribu-
tion), which is associated with a tail risk of 0.5% (confidence level).

Correlation
The final input to this model would be the correlation factor between and within asset classes and between CVA and WWR. Though firms have used the historically based correlation approach, we think this approach does not factor in certain dormant elements that might seem isolated and independent but at times can act with other noise to manifest in unpredictable ways. Several methodologies currently used determine the linear relationships between variables with the correlation coefficients ranging from -1 to 1. (Note: 0 value correlation does not mean zero relationship between two variables; rather, it means zero linear relationship. It is possible for two variables to have zero linear relationship and a strong curvilinear relationship at the same time.)

Though these values represent correlation relationships, they do not determine the extent of correlation. An indication by itself would be meaningless, should the extent or intensity of that relationship be determined in numbers or values. Our recent use of a methodology that measures the strength of the linear or nonlinear association between two variables X and Y has resulted in very interesting observations and the outcome (if implemented) had a markedly precise estimation when compared to realized P&L.

Model Calibration
Traditionally, calibrating model dynamics requires inputs from historical and market-implied measures. From a market-risk perspective, volatility, correlation and other model parameters are factored in. Likewise, from a credit risk perspective, default probabilities and recovery rates are used as model inputs. In the wake of past economic crises and the emergence of new risks, regulators worldwide have devised tougher rules and compliance.

Traditionally, credit risk and market risk were viewed as independent functions, with operational risk hardly worth any attention. Liquidity risk, reputational risk and the emergence of sovereign risk downgrade have stirred up the cauldron of risk.

From the perspective of credit risk and CCR ratings, banks have generally relied on CDS spreads of counterparties (assuming they are traded in the market). Most banks imply the PD from these CDS spreads. This approach has now given way to a more comprehensive methodology as warranted by accounting standards, namely IFRS 13 and Basel III capital requirements. Though this entails bootstrapping of existing tradable securities with that of an illiquid counterparty spread, the actual realized values from an approximation generally differ from a realized P&L.

From a guidance perspective, BIS (Basel III Advanced Method CVA VaR) has created a methodology that factors in PD based on geography, industry, country, etc. to determine counterparty spreads, further compounded by the introduction of expected shortfall as a replacement for VaR.

Traditionally, credit risk and market risk were viewed as independent functions, with operational risk hardly worth any attention. Liquidity risk, reputational risk and the emergence of sovereign risk downgrade have stirred up the cauldron of risk.

To circumvent this complication, we would suggest a macro mapping of each counterparty with model inputs that consider sovereign ratings, not only from an external rating perspective (S&P, Moody’s, etc.) but a bank’s own internal estimate/rating and periodically validated rating change/update. Factors such as GDP growth, current account deficit, political change, weather conditions, currency fluctuations, core business, non-core business, etc. need to be considered and calibrated as far as possible using live data or stochastic to arrive at the most accurate internal rating. Though this might sound overwhelmingly complex and data intensive, we believe that most counterparties are interrelated and base their investment strategy on common worldwide shared interests, information and alerts (e.g., increasing spreads, macroeconomic data, crude prices, commodities, customized data feeds, new/disruptive technology, climate changes/hazards, etc.). Even in isolated or siloed markets, the correlation is all but glaring with the contagion effect (though a blip at times) able to manifest into something larger.

Recovery rates is yet another assumption based on historical data/assumptions. The challenge
is how banks mark recoveries on illiquid names the same as liquid names. We believe that banks ought to have their own internal estimates for recoveries based on an in-depth analysis within their own credit risk team.

**Implementation**

Front-office systems could be vendor specific or internal. Since CVA and advanced CVA are relatively recent, most banks would have systems in place. We believe that whatever the system (vendor or internal), real-time pricing ought to be a standard feature. However, given market conditions and the ever-evolving landscape, application functionality (in terms of specification, build and scalability) should be added as soon as possible. This feature far outclasses a vendor-based functionality. (In terms of a one-size-fits-all criterion, it becomes extremely cumbersome to have a third-party system analyst create a newer version of an existing application. Customization can create as much as is required based on requirement/s.)

Wrong way risk in counterparty and funding exposures is most dramatic in systemic crises and tail events.

The former option (internal systems) would have the advantage of being able to respond immediately to counterparty risk pricing and hedging apart from accounting for netting at inception, portfolio rebalancing/optimization, collateral change/demand, etc.

**Risk Mitigation**

Risk mitigation, though part of an overall CCR and not specific to CVA, requires systems and policies in place such as netting, recouponing and mandatory break clauses. However, DVA and collateral (apart from non-mandatory break clauses) are more subjective and need to be addressed in real time as well. Credit thresholds should also be included as part of the mitigation.

**Hedging**

Several banks calculate their exposure and credit-related sensitivities almost daily with advanced measures/ mitigants such as jump to default and cross gamma apart from traditional delta, gamma and vega measures/sensitivities. With markets in financial derivatives (MiFID 2) in Europe placing restrictions on high speed algorithmic trading (HSAT), the spotlight is now on the entire gamut of derivatives as well. We believe that while hedging would have its limitations (especially if used to speculate or taken as non-hedge – excess one-side exposure), it also would create a potential for reducing risk, especially when hedge rebalancing is done. We believe that portfolio valuation and exposure are directly connected to the hedge ratio and immediate rebalancing or offsetting of positions should be made possible through smart order routing and low latency algorithmic trades. Though hedging can help risk mitigation and serve as a profit center, banks must have a model that is scalable, validated and algorithmically recalibrated in line with changes in macroeconomic data. A combination of high-speed algos with the optionality of manual intervention should be established and internal rules governing each strategy must be laid down and adhered to at all times.

Wrong Way Risk

We now look at wrong way risk (WWR) and its alignment to our real-time CVA calculation.

Wrong way risk in counterparty and funding exposures is most dramatic in systemic crises and tail events. A consistent model of WWR is proposed here with the probability-weighted addition of tail events to the calculation of credit valuation and funding valuation adjustments (CVA and FVA). This new practical model quantifies the tail risks in the pricing of CVA and FVA of derivatives and does not rely on a limited concept of linear correlation frequently used in many models.

WWR - positive correlation between the counterparty’s default and the exposure (mark-to-market or replacement value) - can be particularly harmful to the stability of the financial system and each individual bank’s balance sheet during extreme market dislocations (also known as tail events).
Due to the interconnectedness of the financial system, major systemic or economic shocks are greatly amplified by potential counterparty related losses and funding stresses, and especially so if further magnified by WWR. Importantly, the total large exposures of WWR type are most likely the consequence of a financial institution’s business model due to concentration, leverage and funding risks and therefore deserve close attention and active management on all levels.

The main challenge of WWR is to identify and to characterize various extreme WWR scenarios in order to be able to risk-manage and perhaps to steer or diversify the business away from WWR dangers. The proposed tail-risk model helps to analyze WWR and is designed to be practical and “as simple as possible, yet no simpler.”

In terms of measuring and quantifying CVA WWR, the challenge is to stochastically arrive at a possible WWR event of a particular counterparty in a particular asset class in a particular geography with a rating (example: AAA) with a given exposure, positively correlated with collateral pledged. Some would opine that the collateral pledged should be negatively correlated with the counterparty exposure but then how much of the collateral is liquid is the problem that needs further addressing. To circumvent this problem, we again fall back on our proposed correlation model suggested earlier.

The Model

We consider a single stressed scenario of WWR added to the base model to explain the essence of the model, and subsequently we will generalize to multiple stress scenarios.

A major stress scenario is the sovereign’s default accompanied by various market dislocations. In general, the main assumption of the model is that various stress scenarios (sovereign default, commodities shock, etc.) can be defined in terms of stressed macroeconomic parameters (stressed rates and discount curves, FX rates, commodity and housing prices, etc.) and the probabilities of those stress scenarios. In our example of a sovereign default, the probability of the default can be implied from the sovereign CDS level.

The expected positive exposure (EPE) that enters into the CVA calculation is meant to be the conditional exposure given the default of the counterparty. Since the major dislocation and associated WWR occur only when the sovereign defaults, the total EPE is the probabilistic sum.

RESULTS: The model we created using historical data based on LIBOR rates, risk-free rates, country ratings, parent-child ratings, industry correlation and “noise” announcements (Fed announcements, forecasts, etc.), and political upheavals (Crimea, Brent crude, shale gas, OPEC decisions, etc.) over a three-year time frame displayed a very high degree of precision in terms of counterparty credit quality depreciating or appreciating. Though a few counterparties have come close to defaulting, our sample size was limited to a few industries and to non-live data. In addition to the model calculation of real-time CVA, the champion-challenger model served the dual purpose of correcting the model inputs to factor in adverse or very unlikely events of, for example, the depreciation of the Chinese yuan.

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Though there were indications to this effect in terms of macroeconomic data emanating from markets and rating agencies, a closer look would reveal that several counterparties did anticipate such a move but were unsure as to when this would occur. Several did manage to offset their exposures but the cascading effect on commodities and foreign exchange was immense and led to a downhill sweep in terms of market capitalization (equity market) and erosion of wealth worldwide.

Though this (Chinese yuan depreciation) might be a one-off incident, the perils of an isolated/non-
correlated event not factored in (back-testing or “what if” analysis) could lead to a larger exposure and entail heavy concentrations around the tail leading to the ubiquitous WWR. Though the so-called movement from VaR to the proposed expected shortfall is being debated aggressively, the problems around elicitability will become obsolete, given the likelihood of WWR becoming a reality and occurrences “not so rare” as previously understood.

**Conclusion**

Regulation in the past was reactive, in terms of new legislation being passed in the wake of each disaster. Regulation has now become proactive - a nightmare for banks globally. The G20 grouping virtually covers 90% of the developed, emerging world.

With Dodd Frank, CCAR, DFAST, CLAR, CLASS, AIFMD, MAD, MiFID 2, MiFIR 2 and a plethora of other regulations threatening to limit the sale or trade of certain asset classes, investment banking is under significant pressure.

Regulatory bodies, in their role of insulating retail investors and the industry as a whole, are encouraging banks to be transparent in all their dealings and to report each of their trades in real time so as to preempt systemic risk.

Risk management reports (based on limits/thresholds breached) are sent to board management and regulators periodically but how activity (as in trades and exposures) is conducted needs to be captured, monitored and effectively managed. The role of credit risk management, market risk and operational risk is increasingly being viewed as a composite function under the governance, risk and compliance framework.

How each firm manages to effectively capture counterparty risk, manage exposures, effectively allocate capital in the form of tier 1 or other highly liquid assets, and make provisions for a liquidity buffer will determine the efficacy of risk systems.

**Footnotes**


**References**

About the Author

Raji Kochuvadvana, a Consultant within Cognizant Business Consulting, is pursuing his doctorate in capital markets risk management. He holds a post-graduate management degree from the University of Pune. Having worked with several investment banks such as Lehman Brothers, Morgan Stanley, Knight Trading, VPS (Norway), RBS, Barclays, Nomura, UBS, etc. Raji has been involved in business consulting within the investment banking domain in credit risk, market risk management, and governance risk and compliance. He can be reached at Raji.Vadvana@cognizant.com.

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