

Inherent Complexity and the Quest for **Unattainable Perfection**



By Michael Zerbs

Should firms be able to benefit from the deterioration of their own credit quality?

This question has been at the center of a heated debate since the financial crisis, when several large financial institutions reported massive P/L gains due to the impact of an increase in their own credit spread on their bilateral credit value adjustment (CVA) calculations to the fair value of their OTC derivative positions. Conversely, it is challenging to see how government support to an otherwise bankrupt institution would reduce shareholder value. Huge DVA (debt value adjustment) losses were reported at other financial institutions when government support programs reduced their default probability and narrowed their own credit spread.

It seems though that the frame of reference for these issues is incomplete. We cannot understand the economic impact of the changes in a firm's own credit quality without looking at the balance sheet as a whole. While the use of one's own funding cost to price uncollateralized derivatives has become market standard following the financial crisis, most firms used market Libor rates at the time of the crisis. Had they used their own cost of funds instead, the reported P/L gains might have been smaller.

Derivatives are beneficial to society when they complete markets and enhance available information. Liquid derivative markets can provide more timely and effective price discovery than cash markets. Market participants can create new payoffs and hedge risks that would otherwise remain un-hedged.

However, what if CCR (counterparty credit risk) measures and CVA models became so complex that derivatives could no longer be valued accurately or managed effectively? Wouldn't we eliminate the benefits we were hoping to achieve?

It is important to understand our expectations and assumptions when dealing with inherent complexity, to ensure our efforts are not wasted in a quest for unattainable perfection. It is equally important that our approach is consistent with how we interpret "value" in situations where the firm's own credit risk and funding cost matters.

THE DOMINO EFFECT OF CHANGING ASSUMPTIONS

While assessing potential changes in value is at the core of risk management, the conceptual framework for the valuation of CCR leaves many important questions open. Valuation requires the assessment of the price that is fair between two specific parties taking into account the respective advantages or disadvantages that each will gain from the transaction. However, hypothetical buyers or sellers come with many questions attached. Do they have the same credit quality and funding cost as the firm applying a fair value assessment? Do we assume that they have similar offsetting credit exposures within their netting set as currently seen by the firm itself or is it a buyer with no offsetting transactions? If we do not assume complete similarity and rely on characteristics that distinguish market participants generally, we will observe a P/L event, as the specific situation of any other hypothetical counterparty is likely to be different than the one we currently have.

If we assume complete similarity between the current and any hypothetical replacement counterparty, each firm becomes an island unto itself with valuations that can no longer be compared across firms. When valuations become unique for each firm, the concept of a fair value that is the price paid or received in an active market becomes challenging.

What ultimately matters in the assessment of CCR is the netted exposure or potential loss in the event of default. However, ISDA close-out conventions were defined before CVA, DVA, and FVA (funding value adjustment) were applied to the valuation of derivative positions. Because the valuation adjustments explicitly consider the specifics of both counterparties in a transaction, assessing the valuation impact of a default becomes much more difficult. We need to consider how an assumed replacement counterparty impacts the credit risk perspective of the surviving counterparty, as well as how the replacement counterparty perceives the credit risk of the surviving counterpart.

In a substitution close-out scenario, a third party that steps in to assume the obligations of the defaulted party would consider the credit quality of the surviving party, impacting the valuation at close-out time. It isn't obvious what degree of similarity between the third party and the

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defaulted party in credit quality, net exposures, and offsets to the surviving counterparty should be assumed. If an AA bank has a plain vanilla uncollateralized swap with Greece and Greece defaults, is the substitution deal one where the new counterparty is Germany or should it be Ireland instead? If the answer is Germany, it would be a very different transaction from the one the bank had before. If it is Ireland, it would be more comparable.

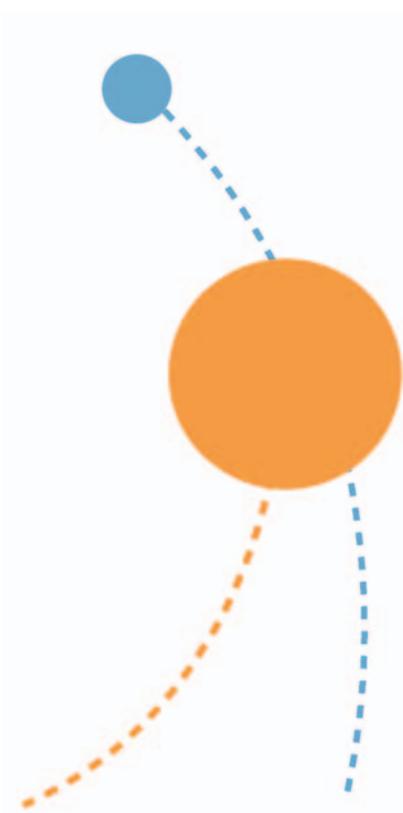
A close-out scenario where we assume the replacement counterparty is risk free may seem preferable, as we do not need to identify identical counterparties. However, a risk free close-out scenario is actually inconsistent with the way CCR is valued through the life of a transaction. Assume that the counterparty to Greece owes money to Greece and has a weaker credit quality than in the example above, for instance at a BBB level. The value of its liability is thus reduced by a fairly high DVA charge. When Greece defaults, the counterparty would face a massive loss in a risk free close-out scenario as its BBB liability would be marked up to AA, which seems counterintuitive and not according to market practice. It also means that from an exposure management perspective banks need to track contingent net liabilities as well as contingent net gains, as liabilities can result in (mark to market) losses at the time of default. This is not how banks track counterparty exposures today.

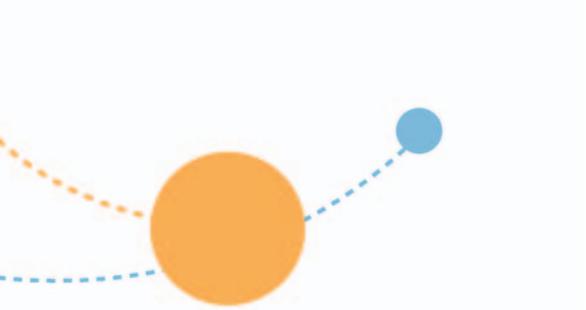
We can conceptually think about these issues in the following way: a derivative transaction between two counterparties, such as a plain vanilla interest rate swap, represents three separate bets: a bet on reference interest rates, a bet on one's own credit quality and a bet on the counterparty's credit quality. In a substitution close-out, do we replace all three bets, or just the main market risk bet? Funding risk would add yet another spread bet, which would also have to be considered in a substitution close-out scenario.

Fair value conventions need to be aligned very carefully with close-out assumptions. If we consider the P/L impact of CVA, DVA, and FVA during the life of a netting set, we should use substitution close-out definition of exposure to avoid inconsistencies and large P/L swings at default time. Unfortunately substitution close-out conventions seem to have very challenging computational consequences: in essence we are required to simulate CVAs at each forward point in each scenario, to determine a "CVA adjusted PFE," which can quickly become computationally infeasible.

If we stay with risk free close-out assumptions, we are conceptually closer to a banking book frame of reference where a loan would be carried at face value until a loss event takes place. However, in this frame of reference we should not change the valuation of CCR when credit spreads change.

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UNATTAINABLE PERFECTION

CVA models are inherently complex, as they require nested layers of simulation with intricate modeling assumptions at each layer. This inherent complexity leaves us with three choices:

1. We can aim to conquer complexity and develop a “model of everything” and aim for a coherent and comprehensive fair value approach that fully embraces a market risk perspective of CCR.
2. We can introduce simplifying assumptions and partial solutions while maintaining the same overall market risk frame of reference.
3. We can change our frame of reference and acknowledge that CCR cannot be transformed entirely into market risk.

The first approach represents a major theoretical and practical challenge. The recent financial crisis has clearly demonstrated the dangers associated with the simplified assumptions of the second path. As for the third choice, we would have to accept that the unambiguous pricing and active management of CCR entirely as traded market risk is not possible. Instead, we would have to address CCR within a broader credit risk capital management framework. CVA measures would still be very useful as credit risk indicators and management tools, influencing our perspective on relative value. However we should not accept them as deterministic amounts that impact financial statements directly without qualitative judgment or uniquely determine hedging strategies.

A LAYER CAKE OF COMPLEXITY

It is important to understand that CVA is calculated at the level of counterparty netting sets, which may each include thousands of heterogeneous underlying derivatives. While efficient closed form solutions for the calculation of CVA exist at the level of individual products, Monte Carlo simulations must be used when estimating CVA at the portfolio level. For each netting set, the CVA calculation builds on thousands of potential future exposure (PFE) simulations. For large firms, each PFE simulation requires hundreds of thousands of derivative valuations, each repeated at many future time

points reaching out to the farthest maturity date in the data set. Some of those valuation models may themselves be Monte Carlo-based models.

Because market risk is about potential changes in market values, we may need to repeat each CVA calculation over hundreds of market risk scenarios to determine CVA capital charges.

Let us assume that we have the computational resources to run simulations (to value complex derivatives) within simulations (to calculate PFE and CVA under today’s market conditions) within simulations (to determine CVA capital charges over a range of scenarios of market conditions) for a large derivatives book on a timely basis.

Our assumption leaves us with many questions. How would we validate the assumptions going into these calculations at each level? How would we ensure their consistency at each simulation layer? When do we use real measures or risk neutral measures? Do we use spot or forward measures? Are some of those measures implicitly mixed? How do we calibrate those measures for large data sets with many risk factors across multiple asset classes? How are we deciding which term structure model to use? How are we evolving fundamental no-arbitrage relationships and other structural relationships? How are we addressing wrong-way risk? What are our assumptions regarding the frequency and lags of collateral amounts?

We also can’t look at CVA in isolation. For instance, CVA modeling should be consistent with a bank’s market risk and incremental risk approach. It is also important that CVA and FVA are computed consistently, so that there is no double counting of funding costs. To further complicate our task, we need to develop and maintain different sets of calibrations for economic and regulatory CVA calculations, as well as for external and internal use.

It is very challenging to understand, validate, and track the many modeling inputs and assumptions within a single firm. It is virtually impossible for outsiders such as the firms’ counterparties, auditors, regulators, or investors to understand these assumptions even if they tried their

best and shied no expense. CVA thus represents a ‘black box’ that outsiders can’t open. This would worsen informational asymmetries and reduce the effectiveness of markets.

DANGERS OF SIMPLIFICATION

We can simplify assumptions in order to reduce complexity and increase transparency. However, we quickly run into several problems that together may make the cure worse than the disease:

First, simplifications in one area may create inconsistencies in another. For example, the “simplified” formula for regulatory CVA under the advanced approach excludes the impact of market risk on CVA, which many firms hedge. Par credit spreads in the regulatory formula are inconsistent with the forward or zero rate models that most firms use to capture incremental risk in their internal market risk model. While it is possible to reconcile or bridge those assumptions, this introduces new complexity and reduces transparency.

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THE HAZARDS OF CVA

The language selected by the BCBS indicates there is no room for customizing the CVA charge to a bank’s desired methodology. The CVA capital charge “must be” based on the proposed formula which is using CDS Par spreads. This may be problematic for two reasons.

First, there really is no clean way to simulate and interpret CDS Par spreads, just as there is no way to simulate bond yields directly. Most of the interest rate term structure literature revolves around zero coupon or forward rates. Likewise, most of the developing literature on CDS and CVA revolve around simulating term structures of Hazard rates. Forcing a simulation of CDS Par spreads is a poor design as it can lead to poorer CVA calculations and leave them ripe for arbitrary modeling decisions, as practitioners will need to choose an interpolation scheme for the term structure of Par Spreads. The choice of specific interpolation schemes can lead to dramatically different results.

Second, as part of the IMM approval process, many banks already have regulator sanctioned simulation models for both interest rates and spreads. Typically, they bootstrap zero curve term structures and simulate these to compute general market risk and specific risk charges. CDS Par spreads for the regulatory CVA charge would represent a parallel way of simulating name specific spreads, resulting in undue complexity and cost.

The explicit inclusion of the CDS Par spreads is tantamount to forcing a particular simulation methodology onto banks that already have IMM approval. This is contrary to the spirit of internal models where banks choose a particular methodology and then defend their approach to regulators. The language adopted for CVA does not follow in the same spirit.

“FACED WITH COMPLEXITY, THE TEMPTATION IS TO SEEK COMPLEX CONTROL DEVICES. IN FACT, COMPLEX SYSTEMS TYPICALLY CALL FOR SIMPLE CONTROL RULES. TO DO OTHERWISE SIMPLY COMPOUNDS SYSTEM COMPLEXITY WITH CONTROL COMPLEXITY. UNCERTAINTY WOULD NOT THEN DIVIDE, IT WOULD MULTIPLY.”

Andrew G Haldane, Executive Director,
Financial Stability at the Bank Of England American Economic Association, Denver, 9 January 2011

Second, simplifications will result in new modeling errors. When firms estimate CVA market risk using numerical first order sensitivities to reduce the number of full CVA revaluations, they may introduce new sources of model risk. Sensitivities may be numerically unstable due to limited sample size. CVA may be a non-linear function in key market risk factors due to the netting and aggregation logic within the underlying exposure calculations. Further, the number of modeling layers and the parameter uncertainty associated with each layer both make it difficult to quantify modeling errors.

Third, simplifications may be materially wrong in exactly those scenarios that matter for risk management and pricing. For example, it is generally assumed that bilateral CVA can be calculated as the sum of two unilateral CVA charges that are independent of each other. However, this approach ignores the impact of the first to default time on bilateral CVA. Because derivative transactions are closed out at the first time of default of one of the counterparties, the future credit risk to the other surviving counterparty also disappears at that time. The standard simplified approach does not capture this effect. Especially when the default dependency between two counterparties is high, which would be the case in any systemic crisis, the resulting modeling error can be quite significant.

BREAKING THE CYCLE

The theory and practice of counterparty risk management are evolving rapidly. However, advanced concepts such as CVA often lead to complexity and “second order” inconsistencies. To avoid phantom profits and losses related to inconsistent assumptions, concepts such as CVA cannot be applied in isolation. Advanced techniques must

also be part of a comprehensive approach that carefully defines funding models and close-out scenarios and considers the impact of risk mitigation and funding strategies on the balance sheet as a whole. They also require a much more careful definition of key conventions, for instance relating to close-out processes, to eliminate ambiguity and ensure consistency of concepts across the board.

A comprehensive and consistent approach to valuing CCR would be appealing. Failing to address the complexities associated with this choice would result in reduced transparency and coherence under both normal and stressed market conditions, which would make the prevention or resolution of a future financial crisis even more challenging.

What we can do is develop a framework that acknowledges that traded credit markets may not have the market structure or depth of liquidity to support the market valuation of credit risk. In this framework, we could approach CCR from a “buy and hold” perspective. As we have seen before, this approach is conceptually consistent with a risk free close-out assumptions. We would essentially accept the fact that we can hedge some aspects of credit risk for some parts of our overall derivatives portfolio, but we cannot do it comprehensively and reliably. In this perspective, we would determine the amount of capital and funding liquidity that is needed to ensure sustainability over a much longer time horizon. We would model gains and losses from defaults and migrations, and calibrate unilateral and bilateral CVA measures over that same time horizon.

With this frame of reference, daily fluctuations in credit spreads or market risk factors wouldn’t matter. Because we would use an unexpected loss measure at a fixed time horizon, substitution or risk-free

close-out conventions would be easier to integrate. At the same time, we could apply a portfolio loss model consistently over the trading and banking book to capture the impact of localized credit mitigation strategies on the overall balance sheet.

The recent Interagency Supervisory Guidance on Counterparty Credit Risk Management issued jointly by the main US regulators made a related point: “Banking organizations may use the same percentile for CVA VaR as they use for market risk VaR. However, the time horizon for CVA VaR may need to be longer than for market risk (for example, one quarter or one year) because of the potentially illiquid nature of CVA.”

Risk neutral CVA over shorter time horizons would still play a useful role: it would serve as an indicator of credit risk and would also allow firms to identify those partial credit exposures that can be hedged actively. It would help firms refine their pricing of credit risk, reducing opportunities for adverse selection. Used in this way, CVA would provide additional transparency, reduce informational asymmetry, and nudge markets closer to completion. Because we would not need to ensure full valuation coherence across the board, complexity would be contained and lead to a more consistent approach on how “fair value” is interpreted.

As regulators proceed in their fundamental review of the trading book regime, they will have to evaluate together with the industry how much complexity they can accept and how much coherence in measures and scope they will demand. It is to be hoped that this article can be helpful in this process by crystallizing some of the main challenges and by concentrating the discussion on the key choices that can be made. ■

