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ADAPTIV

Risk management, risk-based pricing and operational solutions

WHITE PAPER

CLOSING IN ON THE CLOSEOUT PERIOD

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1. Introduction

The credit exposure created by OTC trading can be considerable, as many institutions found out during the credit crisis which started in 2007 and saw Lehman Brothers and a number of monoline insurers fail. Increasingly, it is not just the loss of default which is taken into account, but also the change in market value of the OTC trading book due to changes in the credit spreads, a concept known as the Credit Valuation Adjustment (CVA) ^[1].

A number of techniques have been devised over time to reduce the inevitable credit exposure incurred. They include netting agreements, collateral agreements, termination options, central counterparty clearing and bought credit protection in the form of credit default swaps or insurance. In this paper we will be looking in some detail at the implications of collateral agreements.

Collateral agreements are a key instrument to reduce the credit exposure from OTC trading. According to ISDA ^[2] there were 149,518 collateral agreements with a total collateral amount of USD 2.9 trillion outstanding in 2010. For the 83 institutions ISDA surveyed, 73.1% of all OTC exposure was covered by collateral.

More importantly, these collateral agreements seem to perform as intended. According to a calculation made by ISDA ^[3] based on data from the OCC ^[4] the US banking sector incurred losses due to counterparty default on OTC transactions of less than USD 2.7 billion in the period from 2007 till 2010, a period which covers the worst of the financial crisis. Considering that in the beginning of 2007 ^[5] the gross credit exposure from OTC transactions was USD 1,214 trillion, the loss is relatively low. These losses do not include deterioration of market prices or CVA effects.

2. Collateral agreements and closeout effects

The most common collateral agreement by far is the ISDA Credit Support Annex (CSA). In 2010 90% of all collateral agreements in use were ISDA agreements ^[4]. These agreements can be uni- or bilateral, and define legal entities and trade types covered by the agreement, with what frequency of margin calls. They typically stipulate a threshold amount (the minimum exposure to be reached before any calls are made), a minimum transfer amount (the minimum change in exposure required before a call is made) and they can include an independent amount (collateral required 'up front', independent of any exposure).

Apart from the obvious effect of reducing the exposure by any collateral already held, collateral agreements also reduce the future exposure, precisely because margin calls will be issued and collateral will be received as soon as the exposure starts rising. But even if all transactions with a given counterparty are covered by the agreement, and the threshold and minimum transfer agreements are low (or even zero), the exposure doesn't quite disappear. This is due to the closeout effect.

Consider what happens when a counterparty defaults. Even if the agreement states that collateral calls are made daily, it will take some time to realise what is happening. It is not because collateral due is not received on any given day that a counterparty is in default. It might just be an operational problem on the counterparty's side. Once it becomes apparent that the worst is happening, the counterparty needs to be closed out. Apart from the necessary legal steps, this means that replacement transactions need to be concluded for whatever was outstanding with the counterparty and that any collateral received needs to be sold. This is highly dependent on the size and liquidity of both the outstanding transaction portfolio and the collateral portfolio and during that time the transaction exposure can keep rising and the collateral value can keep falling, causing significant losses.

It is necessary to make some assumptions as to how long this closeout period could be. The full closeout period is defined as the time from the margin call being issued to the point where all collateral is sold and the transactions replaced, whichever takes longer. The Basel Committee on Banking Supervision ^[6] recommends that for large netting sets (with 5,000 outstanding transactions or more at any point in time) or for cases having liquidity issues, the minimum closeout period assumed should be 20 business days, with some exceptions. Most banks take this to mean that the minimum is 20 business days, which translates into 30 calendar days, for all collateral agreements. The entire period is usually referred to as the "margin period of risk" (MPR).

Calculating what happens during the MPR is not easy. A number of analytical approximations are possible, but the consensus in the market is that the only precise method to assess the losses is to run a Monte Carlo simulation, which generates correlated scenarios for all relevant risk factors (such as FX rates, interest rates, implied volatilities, etc.), which then allow all transactions to be valued under every time point at every scenario, and hence can predict which collateral calls will occur under the different scenarios. An overview of the principles of the simulation approach can be found in ^[7].

For all the beneficial mitigating effect collateral agreements have, there is an additional effect that should not be ignored. When a large out-of-the-money transaction matures, and a bilateral collateral agreement is in place, a large payment needs to occur before the collateral is received back.

For a transaction that is deeply out-of-the-money, we will have posted collateral already under the agreement. If the transaction is e.g. an FX forward, then at the end the principal amounts need to be exchanged. The settlement will cause a sudden increase of exposure on the counterparty (or a sudden drop in their exposure on us), and this means we can issue a collateral call to receive some of our collateral back. If the counterparty defaults after the settlement of the transaction, but before returning the collateral, then there is a potential loss. The situation where more collateral has been posted than our current exposure is usually referred to as "overcollateralisation".

There is no consensus in the market about whether this overcollateralisation should be treated as exposure. Some banks argue that if the collateral is held with a third party it is always returned eventually, regardless of the default of the direct counterparty. Some even argue that the settlement can be withheld if the collateral is not returned first. But most institutions agree that the conservative approach is that overcollateralisation is to be treated as exposure, at least in those cases where the collateral is held by the counterparty, as the legal uncertainty is significant. This implies that a collateral agreement can actually increase exposure in some cases, as the overcollateralisation does not occur if there is no collateral agreement. For a further analysis of overcollateralisation please refer to ^[8].

3. Example exposure profiles

For a collateral agreement covering all transactions with daily margining, a threshold of zero, a minimum transfer amount of zero and an MPR of zero days (i.e. the counterparty posts/returns all collateral always on the same day), the total exposure will also be zero (ignoring any intraday effects for the sake of simplicity). As soon as any exposure moves a new collateral call is issued and it is honoured immediately. But we already know that this is not realistic.

In order to develop some intuition for what exposure profiles can look like, and what the impact of the MPR on the exposure profile is, we present a very simple example here. We will first look at expected exposures, i.e. the average of all scenarios and then at a confidence interval.

Assume a single counterparty, which has all its transactions covered by a Master ISDA Netting Agreement with a CSA attached, with only two transactions outstanding. This is an unrealistically small transaction number, but it will allow us to spot exactly what happens to the exposure profile. The two transactions are an FX Forward which matures in 96 days from now and an IRS which expires in 1831 days from now.

Below are the profiles for expected exposure (i.e. averaged across all scenarios), for four different cases:

- Without the effect of any netting or collateral
- With netting and collateral, with a 10 calendar day MPR
- With netting and collateral, with a 20 calendar day MPR
- With netting and collateral, with a 30 calendar day MPR.

The first case assumes that there are legal problems with the netting and collateral agreement, and show the exposure on a gross basis. The other three cases show the effects of both netting and collateral, but with progressively more pessimistic assumptions for the closeout period. Only the last case shows an MPR compatible with what the Basel regulation recommends for large netting sets, which is 20 business days and hence 30 calendar days.

For the sake of simplicity the collateral agreements all assume daily margining, a threshold of zero and a minimum transfer amount of zero, which means that margin calls start occurring as soon as there is any exposure. So the only variable being changed for the collateralised exposures is the length of the MPR.

Obviously, the exposure without credit mitigation is much higher than any of the other profiles. But even within the different closeout assumptions there are large differences. Whenever a major event occurs, such as the FX Forward maturing at 96 days, the various collateralised exposure profiles only drop down after their MPR, because it can take that long to close out the counterparty. But even at any other time, assuming the MPR to be longer leads to higher exposure, quite simply because there is more time for the exposure to diverge before the counterparty can be closed out.

For the 99% confidence interval, similar effects can be seen for all four cases, but they are even more pronounced.

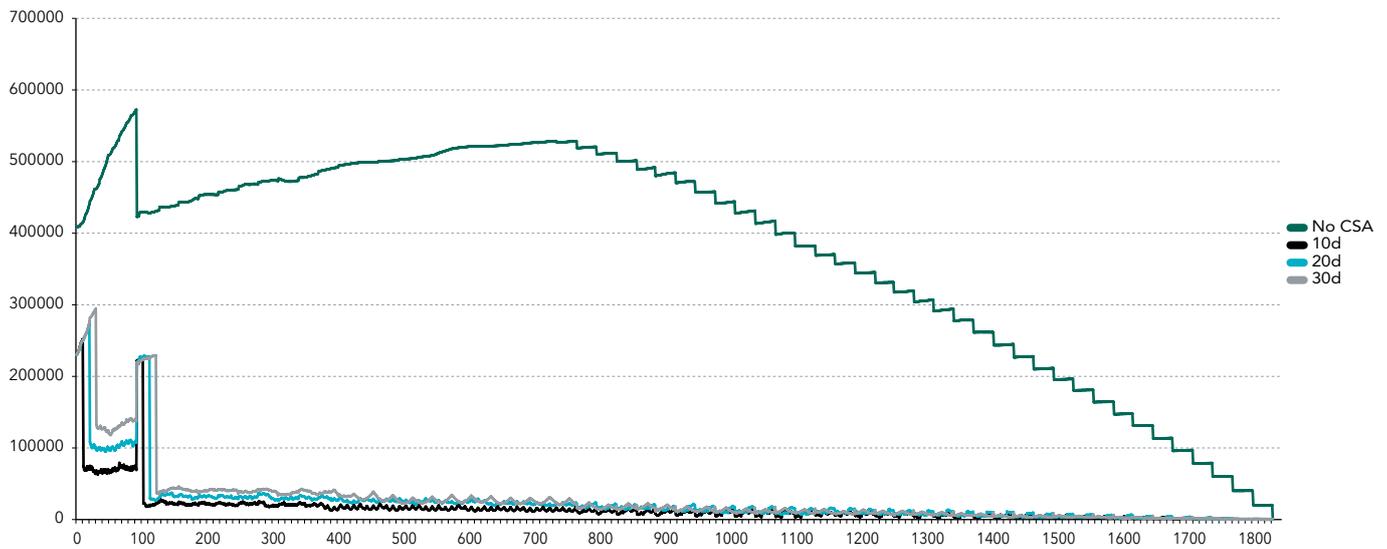


Figure 1: Expected Exposure Profiles

4. CVA and why the bilateral calculation matters

In order to manage the risk of a sudden loss from a counterparty defaulting, obviously only our exposure on them matters, and not their exposure on us. In fact, if there is any exposure from them on us then this is good news, from a credit risk perspective, because as long as there is a netting agreement in place this will mean that we enter into new transactions with them with a lower probability of incurring any net exposure at all.

But exposure numbers are not just used to manage the risk of default. They are also necessary to calculate the Credit Valuation Adjustment (CVA). CVA is loosely defined as the cost of hedging the credit risk. As such it requires not just the exposure profile, but also the credit spread, usually taken from the CDS market (either directly or using a proxy). CVA is used for a number of purposes, including the reflection of credit effects into accounting, the support of credit hedging decisions and the pricing of new transactions. Please refer to ^[1] for a more detailed description of CVA and its uses.

CVA can be calculated unilaterally, taking into account only the credit risk we take on the counterparty, or bilaterally, which also takes into account the fact that the counterparty takes credit risk on us. The bilateral calculation has been the subject of intense debate, as it can lead to counterintuitive effects, such as benefiting from your own downgrade, but many practitioners now agree it is the best measure at least for initial pricing, as it takes all known effects into account. For the same reason, it is also the preferred measure for risk management and hedging decisions. Bilateral CVA is now used in most countries in the accounting regulation ^{[9][10]}.

When Ernst & Young surveyed 16 financial institutions in 2010, they found that 9 used a unilateral calculation and only 6 a bilateral calculation, but with a clear trend for more institutions to start calculating bilaterally in the future ^[11].

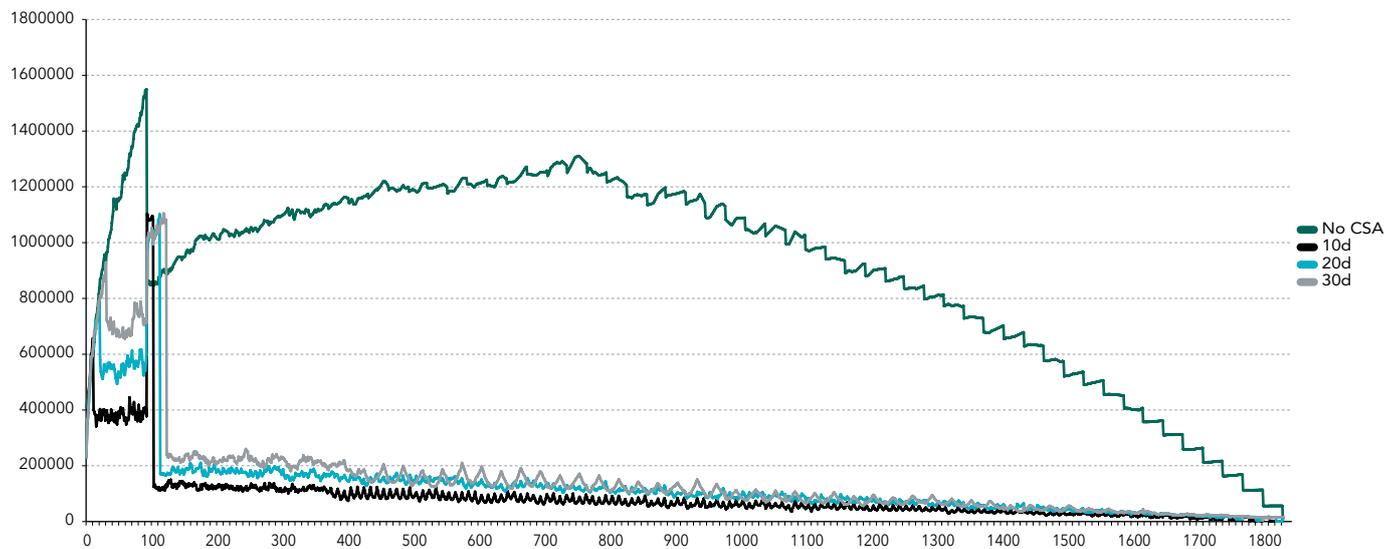


Figure 2: 99% Confidence Interval Profiles

5. Symmetric calculation with equal closeout assumptions

The most straightforward way to calculate the exposure is to use the same assumptions for our exposure on the counterparty as for their exposure on us. This is not only an elegant solution, it also guarantees that as long as the counterparty calculates using the same assumptions and the same pricing inputs, we will agree on the price of the transaction. Obviously, the price we agree on is the outcome of a negotiation. It is not just a modelling exercise. But the least that can be expected from a model is that all parties involved (or even third parties) get to the same result if they make the same assumptions. This will also make sure that if we re-price the transaction as soon as it has been booked, there will be no sudden shock in the price.

There is one major drawback in this straightforward solution: in order to calculate our exposure on the counterparty, we have to assume that the MPR is a significant amount of time. Let us assume that we use the 30 calendar days recommended by the Basel regulations. For exposure simulation purposes, this implies the counterparty returns collateral only after 30 days (see section 2). But if the calculation is completely symmetric then we should assume not just that the counterparty only returns collateral at the end of the closeout period, but that we ourselves are doing likewise.

Just to make the consequences of this assumption explicit: in any one exposure scenario there are typically collateral calls both ways, as exposure values change over time, and when we call for collateral we assume that the counterparty, instead of honouring the agreement, only posts/returns collateral after a 30 day period. This is quite a conservative assumption, but it is in line with the Basel regulations. But we also assume that when we receive a collateral call, that we will, in clear breach of the collateral agreement, only post/return collateral after 30 days.

Even though this type of exposure calculation would technically work, and lead to a price everybody can agree on –assuming everybody uses the same assumptions– it is not reasonable to assume we will break a legally binding agreement in order to make a calculation work.

6. Asymmetric calculation

In order to deal with the major objection to the calculation as proposed in the previous section, let us change the assumptions as follows: when the counterparty needs to post/return collateral, we assume they will do so only at the end of the closeout period, but when we post/return collateral, we do so as per what the collateral agreement requires, which is typically the business day after receiving the call. This clearly still complies with the conservative assumptions made by the Basel regulation, and it no longer assumes we would be breaking any legal agreement.

However, the calculation is now no longer symmetric. We are using a conservative assumption when looking at our risk on the counterparty, but when we consider their risk on us we systematically make far more optimistic assumptions, as any collateral we owe them is assumed to be settled immediately. A traditional risk manager might claim that this is as it should be, but it unavoidably leads to us no longer agreeing on the initial price with the counterparty. If they would use the same underlying principles, even with all the same pricing inputs, we would come up with a higher price than them, because we would want compensation for the high credit risk on them whilst 'underestimating' their credit risk on us. Any third party valuing the transaction, e.g. a valuation agent, would also disagree, as there is no reason to make different assumptions for two counterparties in the same transaction.

Again, this type of calculation would technically work, but it is even worse than the one described in section 5, because it is not just unreasonable, but it doesn't even lead to a valuation everybody can agree on.

7. Symmetric calculation with unequal closeout assumptions

In order to deal with all the objections from the previous two sections, yet another type of calculation is possible: we first calculate the exposure, under every scenario, at every point in time, assuming that the counterparty will only post/return collateral after a full closeout period but we will honour each call immediately. We use this to calculate the unilateral CVA from us on them.

This may sound like an asymmetric calculation again, just like the one from section 6, but so far we only calculated the unilateral CVA from us on them. We know we need to get to bilateral CVA.

The next step is to calculate the exposure from them on us, assuming this time that we will only post collateral at the end of the closeout period, but they will honour each call immediately. This is then used to calculate their CVA on us, something also known as the Debit Valuation Adjustment (DVA). This, of course, sounds dangerously like the calculation we rejected as unreasonable in section 5. But there is a big difference here: we are now calculating two completely different sets of exposure profiles, and the second one is only used to understand how they will be viewing us.

Once we have both numbers we can subtract the DVA from the unilateral CVA to obtain the bilateral CVA. Those familiar with the subject will notice that we have not taken into account any 'first to default' effect in here. For the sake of simplicity we will not address it here, but rather in section 8.

Please note that this calculation is completely symmetric. If both counterparties, or, for that matter, any third party use this method with the same pricing inputs, then they will arrive at exactly the same result. The drawback is that we have two different sets of exposures (but still only a single set of valuations), which increases the calculation overhead, but this is the only calculation so far under which everybody agrees on the price of the transactions without anything unreasonable happening in the process.

8. Combination with other effects

There are a number of other effects which affect the calculation of CVA and which have not been addressed so far in this paper. Most of these are typically smaller than the impact of the MPR, but that obviously depends on the specific circumstances. The four main effects are:

Wrong Way Risk (WWR): this refers to the correlation between the default probability (as backed out from the credit spread) and the (factors driving the) exposure. If a counterparty is deep in the money when default is more likely then CVA will be higher. This effect does matter in practice, but it does not change our conclusions about the modelling of closeout periods. A further discussion of Wrong Way Risk can be found here ^[12].

First To Default (FTD) correction: CVA only matters if you as an institution survive long enough to suffer any ill effect from your counterparty defaulting. If you default before they do, then under those scenarios CVA was irrelevant and hence should not be added to the total. This effect is typically very small. But if your own default probability is relatively high and you are strongly correlated to the counterparty, then this can start to matter as well.

It is worth pointing out that the FTD correction is relevant even for unilateral CVA: even for the unilateral calculation you can model in which cases you default before the counterparty does, and this will reduce the CVA. For a bilateral calculation the scenarios in which the counterparty defaults before you do reduces DVA, so that the total effect on bilateral CVA can be up or down. For a further analysis of the FTD effect, with practical examples showing that it only matters once the correlation becomes very high, please refer to ^[13].

Risk-free versus substitution closeout: at default, transactions need to be settled at their current mark-to-market value. To compute that value it matters whether the surviving counterparty is assumed to be risk-free, or whether its default probability should be taken into account. Any assumption made about the creditworthiness of the counterparty the replacement transaction is done with also matters. For a rigorous treatment of this effect and the FTD effect please see ^[14].

Funding Adjustment: Apart from CVA there is also a Funding Valuation Adjustment (FVA), also known as the Liquidity Valuation Adjustment (LVA), which deals specifically with the cost of funding.

9. Conclusion

Collateral agreements can reduce credit exposure drastically. But as any collateral agreement still takes time to close out in the event of default, the exposure does not completely disappear. The assumptions made for the closeout materially affect the calculated exposure and hence lead to different decisions in taking on new exposure.

The first major assumption is the length of the MPR. If we assume a longer period, then the exposure will be higher. How long exactly the period should be depends on an assessment of how much time it would take to replace transactions and sell collateral in the event of a default. The Basel Committee recommends 20 business days minimum for netting sets which are large or hold complex transactions.

Another significant assumption is whether the closeout period assumed for the counterparty can be assumed for one self. It is intuitively wrong to assume one would be posting collateral late and hence breaking an agreement, and it is certainly not a conservative assumption. This makes the calculation difficult as it should be symmetric for any two parties ever to agree on the price of a transaction. After looking at a number of alternatives we concluded that the best method is the one described in section 7, where exposure is calculated from both our own and the counterparties point of view and the (long) MPR period is only modelled for the party where the credit risk originates.

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