Margining and Collateral as CCR Mitigation Tools

We present review of margining as Credit Counterparty Risk mitigation tool in OTC derivative trading based on International Swap and Derivative Association standards. Practical part of paper contain demonstration of impact of margining thresholds, amounts and timing parameters on portfolio exposure.

Collateral as Risk Management Tool
Credit risk occurs in the OTC derivatives trading whenever a counterparty to a transaction has an obligation to make payments or deliveries in the future.

International Swaps and Derivative Association (ISDA) defines four main methods of addressing the credit risk arising from a derivatives transaction:

- capital allocated against the exposure,
- reducing credit risk through close-out netting;
- financial guarantees;
- collateral posted against exposure.

Collateralization works best in those cases where the volume of activity is sufficient to warrant bearing the operational and procedural burdens associated with the sophisticated collateral process, provided that a legally enforceable claim can be established against collateral. Therefore, there are cases where it is simply more cost efficient or legally effective to rely on other methods of credit risk mitigation. Nonetheless, collateralization remains among the most widely used methods of mitigating counterparty credit risk in the OTC derivatives market, and market participants have increased their reliance on collateralization over the years. In an evolving regulatory environment that broadly seeks to reduce the counterparty risk associated with derivatives, the continued use of bilateral collateralization has an important role to play in risk mitigation (1).

Objectives of Margining
Margin requirements for non-centrally cleared derivatives have two main benefits (2):

Reduction of systemic risk.

Only standardized derivatives are suitable for central clearing. A substantial fraction of derivatives are not standardized and cannot be centrally cleared. These non-centrally cleared derivatives, totaling hundreds of trillions of dollars in notional amounts, pose the same type of systemic contagion and spillover risks that materialized in the recent financial crisis. Margin requirements for non-centrally cleared derivatives would be expected to reduce contagion and spillover effects by ensuring that collateral is available to offset losses caused by the default of a derivatives counterparty.

Promotion of central clearing
In many jurisdictions, central clearing will be mandatory for most standardized derivatives.

Margin and capital
Both capital and margin perform important and complementary risk mitigation functions but are distinct in a number of ways. First, margin is “defaulter-pay”. In the event of a counterparty default, margin protects the surviving party by absorbing losses using the collateral provided by the defaulting entity. In contrast, while capital adds loss absorbency to the system, because it is “survivor-pay”, using capital to meet such losses consumes the surviving entity’s own financial resources.
**Mechanics of Margining Agreements**

Margining agreements for OTC transactions are usually documented in Credit Support Annex of ISDA Master Agreements.

According to ISDA, 73% of all OTC derivative trades (cleared and non-cleared) were subject to collateral agreements of which 87% are ISDA agreements (1).

Margining agreement between two counterparties is optional set of rules which contains terms and conditions concerning the posting and return of collateral, the types of collateral that may be used, and the treatment of collateral by the secured party.

Typical CSA collateral agreement contains terms and condition describing following issues of collateral posting:

**Collateral Delivery Timing**

Valuation date and call period state dates at which collateral should be posted and time period between calls.

As margining process is discrete, exposure is reduced to zero on every valuation date but can be positive between margin calls. Clearly, higher frequency of payments (shorter call period) would lead to lower exposure level (see demonstration below).

Bank’s exposure is usually fully covered under daily margining, but still can be above zero as margining payments have one day settlement period. This difference can be covered by Initial Margin which we discuss later.

CSA can also define settlement period of collateral delivery. This option, in general, will have no effect on exposure, but can cause additional losses during close-out period (time period between default and portfolio close out).

**Thresholds**

Margining Threshold (TH) is the amount of exposure which will not be covered by collateral. In other words, counterparties do not deliver collateral if credit support amount (we use UE notation, uncollateralized or unsecured exposure) is less than margining threshold. Margining agreements on Figure 1 have zero threshold – full credit support amount is paid on margin call. Figure 2 shows previous exposure profile with Margining Threshold specified at 10. As in previous example, Margined Exposure usually vary around TH between margin calls, but can never be above TH in case of daily margining (call period is 1 day).

To avoid additional operational expenses, counterparties usually do not deliver credit support amount less than Minimum Transfer Amount (MTA). In terms of exposure analytics MTA has similar effect as TH.

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(1) ISDA Agreements: 64%, Non ISDA Agreements: 9%, Non-Collateralized: 27%
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Initial Margin and Independent Amount
Timing and threshold parameters control Variation Margin posted by counterparty. Additionally, CSA may require posting fixed amount of collateral to protect against the gap risk that may arise between margin calls.

Initial Margin Amount (IMA) – amount of collateral posted to counterparty according to bilateral agreement in front of entering transaction. Independent Amount (IA) is analogous to IMA required by futures clearinghouses to collateralize potential counterparty exposures.

The size of Initial Margin Amount can be approximated by expected volatility of the portfolio between two margin calls, $\Delta t$:

$$IMA = \sum \frac{\partial E}{\partial p} \cdot \Delta p + \frac{\partial PFE}{\partial t} \cdot \Delta t,$$

where $\frac{\partial E}{\partial p}$ is set of delta equivalent positions for vector of market factors $p$, and $\frac{\partial PFE}{\partial t}$ is PFE change taking into account term structure of contract.

It should be noted that although the terms “Independent Amount” (bilateral) and “Initial Margin” (clearing) can be thought of as equivalent and are often used interchangeably in the market, this superficial equivalence should not give the impression that they are calibrated similarly. To the contrary, IA and IM exist in two totally different contexts: IA provides protection against default loss in conjunction with bilateral Variation Margin and regulatory capital; whereas IM provides protection in conjunction with clearinghouse Variation Margin and the rest of the clearinghouse waterfall of protections against default impacting a clearing house (1).

All delivered and received IA and IMA are generalized to Net Independent Collateral Amount for capitalizing purposes:

$$NICA = IA_{received} - IA_{paid},$$

and Net Initial margin:

$$NIMA = IM_{received} - IM_{paid}.$$ 

In other words, IA is applied on netting set level to define credit support amount to be covered by counterparty:

$$UE_B = \max(0, MTM - TH_B - NICA),$$

or collateral to be posted to counterparty:

$$UE_A = \max(0, -MTM + TH_A + NICA).$$

And IM is added to this amount to compute full collateral available:

$$C = \max(0, MTM - TH - NICA) + NIMA.$$ 

Taking into account all mentioned above, transaction exposure which is subject to margining agreement at any margin call date is reduced to sum of thresholds less netted independent amounts:

$$E_{mc} = \max(0, TH + MTA - NICA).$$

$TH + MTA - NICA$ represents the largest exposure that would not trigger a variation margin call and it contains levels of collateral that need always to be maintained. For example, without initial margin or IA (as defined in the ISDA Master Agreement), the greatest exposure that would not trigger a variation margin call is the threshold plus any minimum transfer amount. In the adapted formulation, NICA is subtracted from $TH + MTA$. This makes the calculation more accurate by fully reflecting both the actual level of exposure that would not trigger a margin call and the effect of collateral held and/or posted by a bank. Note, that bank may hold NICA in excess of $TH+ MTA$ (2).

Thus, at any future horizon exposure can be represented as:

$$E(t) = \max(0, MTM - NIMA - C(t)).$$
where \( C(\tau) \) – net collateral value after last successful collateral call \( (\tau < t) \) which does not into account NIMA:

\[
C(\tau) = \max(0, \text{MTM}(\tau) - \text{TH}_B - \text{MTA}) - \max(0, -\text{MTM}(\tau) + \text{TH}_A + \text{MTA}).
\]

Note, that NICA is not taken into account when computing credit support amount covered by \( C(\tau) \) as it is designed to protect against default between margin call and default.

### Eligible Collateral Types
CSA also defines asset classes which can be placed as collateral.

The use of cash collateral for collateral proposes remains very high, consistently around 80 percent for the past several years (1). However, Government Securities, Equity, Commodity and other types of assets can also be used for this purpose. However, risk weights (haircuts) can be applied to convert nominal value of asset to risk-free value.

### Margining Effects in Practice
Current value of exposure its future profile can be easily derived using analytical functions presented above if marked-to-market value is known. However, we are interested in impact of margining on future exposure profile given uncertainty of market levels. Obviously, marginal effects of margining agreements cannot be derived analytically due to complexity of simulation of market factors used to price future exposure values.

Following section presents effect of different types of margining on portfolio of trades. We simulate portfolio trades under different margining agreements to show what impact thresholds, amounts and collateral haircuts have on margined exposure. We follow ISDA methodology described above to define terms and conditions of margining agreements.

### Portfolio description
Sample portfolio contains 25 trades (total notional 2.7 bln.) with different deal types and underlying assets. Transactions are performed in different currencies. Top 5 traded products include: Interest Rate Swaps, Cross Currency Swaps, Credit Default Swaps, FX Future, and Single Barrier FX Options.

Customer base include 5 counterparties and legal documents with netting agreements. Portfolio notional is balanced across netting sets and counterparties.
Exposure Results

Using PrevioRisk software we simulate portfolio of derivatives to demonstrate the effect of margining on future exposure.

Results for PFE and EPE calculated taking into account the margin agreements described above are presented on the diagram below.

As can be seen from diagram, margining effects of agreement with timing parameters only (cases 1, 2 and 3) were not homogeneous for peak and expected exposure (aggregated exposures are presented in table below). Thus, we first try to understand the reason of this observation.

<table>
<thead>
<tr>
<th>Case</th>
<th>Peak PFE</th>
<th>Peak PFE benefit</th>
<th>EPE</th>
<th>EPE benefit</th>
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</thead>
<tbody>
<tr>
<td>Base</td>
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<td></td>
<td>16.4</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>31</td>
<td>-21%</td>
<td>3.4</td>
<td>-79%</td>
</tr>
<tr>
<td>2</td>
<td>5.4</td>
<td>-86%</td>
<td>0.9</td>
<td>-95%</td>
</tr>
<tr>
<td>3</td>
<td>2.6</td>
<td>-93%</td>
<td>0.4</td>
<td>-98%</td>
</tr>
<tr>
<td>4</td>
<td>17.6</td>
<td>-55%</td>
<td>9.3</td>
<td>-43%</td>
</tr>
</tbody>
</table>

Note, that maximum maturity of derivatives is one year. Thus, margining on regular basis makes exposure fully covered by margin at margin call (since TH=0). That gives significant reduction of expected exposure because trades “forget” previous exposure history after each margin call margin call (see demonstration below).
Thus, expected exposure computed over time horizons falls dramatically as each future horizon benefits from margin call. Peak exposure, in contrast, may occur before first margin call (for example, interest rate swap usually has decreasing exposure profile). Thus, some trades may not benefit from margining in terms on PFE (left panel on the chart below).

Note, that with margining period less than revaluation horizon (usually one month) PFE benefit would also be close to 95-98% (right panel on the graph below). Adding thresholds and initial margin raise exposure on trade level up to TH+MTA as this amount is usually not transferred.

**Conclusion**

We discussed main parameters of margining agreements and demonstrated impacts of margining on future exposure. In general, margining is one of the most effective methods of CCR mitigation.

As expected, margined EPE decreases with more frequent margin calls. Daily margining can give up to 98% reduction to exposure assuming zero thresholds. Adding thresholds assumes that exposure will not be covered by margin fully. Margining has different effect on mean and quintile exposure: mean exposure falls dramatically under margining.
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**About the Author**
Alexey Malashonok is Head of Research and Product Development at Compono Strategia. He has 7 years of experience in the area of risk management, with a focus on quantitative modeling in credit risk and market risk, stress-testing, and emerging markets. Having worked with a number of leading public and private financial institutions, Alexey used his pragmatic knowledge and technical skills to help them achieve higher performance in the business processes.

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