Netting Effects in Counterparty Credit Risk

This paper presents brief summary of netting principles and effects in Counterparty Credit Risk. We discuss advantages, types of netting and main concepts for institutions with derivative portfolios. From the practical point of view, we first implement concept of netting with simple examples and then show netting effects for simulated portfolios of derivative transactions. In addition to collateral and margining, netting is one of main methods of CCR mitigation.

Close-out netting

Close-out and netting consist of two separate but related rights, often combined into a single contract (1):

- The right of a counterparty to terminate contracts unilaterally under certain specified conditions (close-out).
- The right to offset amounts due at termination of individual contracts between the same counterparties when determining the final obligation (netting).

Note, that the fact that trades are aggregated together in case of counterparty default implies that collateral and margining agreements are applied to netted exposure which leads to lower exposure than the non-netted exposure.

Illustration of the exposure of two trades with and without netting is given below.

Suppose there are two Interest Rate Swaps with different underlying interest rate that take values -100 and +120 to one Counterparty. Assume no collateral and margining for simplicity:

<table>
<thead>
<tr>
<th>Trade</th>
<th>PV</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-100</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Non-netted Portfolio</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>Netted portfolio</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

If the counterparty defaults, there would be a loss due to having to settle the trade with the negative value but not being unable to claim (either directly or via offsetting) the trade that has a positive value.

Total value of those trades is -100+120=20. Current exposure is 0+120=120 under no netting agreement. Thus, company would need to allocate capital based on this value to cover CCR risk. Alternatively, counterparty should allocate collateral in amount of 120 to cover this exposure.

However, if trades are subject to netting agreement, then they can offset each other; Current Exposure of netted portfolio falls to 20, which significantly reduces CCR capital and risk cost. Counterparty now need to allocate collateral only by this amount.

Total portfolio exposure is the sum of non-netted exposure (each trade is separate netting set) and netted exposures across all sets.

Note, that both trades are still sensitive to market factor fluctuations. Since those trades do not belong to one hedging set (underlying market factors are different) and may have not perfect negative correlation. Thus, netting does not affect market risk.

Below we present typical example of two trades, which offset each other, thus, reducing peak values of exposure profile. Non-netted peak exposure is 16.5. Netted exposure is 8.5. Netting benefit – amount by which peak PFE is reduced due to netting – is difference between netted and non-netted peak PFE.
Netting Effects in Credit Counterparty Risk

Figure 1. Netting Benefit (NB) demonstration. Top chart – trades values profiles over time. Bottom chart – non-netted portfolio exposure (black), and netted portfolio exposure (red). The difference between netted and non-netted exposure is Netting Benefit.

Netting means that individual exposures of transactions are non-additive:

\[ E(N) \leq \sum E_i, \quad i \in N, \]

which is beneficial since the overall risk is likely to be reduced substantially. However, this lack of additivity does make the pricing of counterparty risk more complex (1).

Let’s discuss formal definition of netting.

Netting in Details

In terms of risk calculations and reporting, the netting dimension is crucial because it partitions a portfolio into nettable and non-nettable positions (2).

Let’s define Current Exposure of position as positive part of Present Value:

\[ E_i = \max\{V_i, 0\}. \]

Similarly, at netting set \( N \) exposure is:

\[ E(N) = \max\{V(N), 0\}. \]

Non-netted exposure is a sum of all exposures:

\[ E = \sum E_i, \]

where \( V_i \) and \( V(N) \) are the transaction and netting set MtM values. The netting set present value is the sum of all transaction values across the netting set:

\[ V(N) = \sum V_i. \]

In presence of a legally enforceable margin agreement, the exposure at time \( t \) is reduced by the amount of collateral. Formally we can define the collateralized exposure as:

\[ E_i = \max\{V_i - C_i, 0\}, \]

\[ E(N) = \max\{V(N) - C(N), 0\}, \]

where the terms \( C_i \) or \( C(N) \) represent the amount at \( t \) of available collateral posted at transaction or netting set level.

Simple manipulations shows that netted exposure is always less or equal than non-netted exposure since there could be trades with opposite value \( V_i \) offsetting each other before taking max:

\[ E(N) = \max\{\sum V_i, 0\} \leq \sum \max\{V_i, 0\} = \sum E_i. \]

Expression above implies that if portfolio contains trades with positive value only (or with negative value only), then there would be no netting effect on exposure.

In corporate business relations, netting in most cases is not a significant issue. Generally, a company either buys from or sells to another firm similar contracts, but rarely does either simultaneously or with different underlying assets. Therefore, in the event of bankruptcy, few if any contracts could be netted or set off. However, banks and financial institutions often generate large numbers
of bidirectional multi-asset transactions between counterparties. Thus, netting can significantly reduce netted exposure of derivative portfolios.

Simple Portfolio Simulation
Portfolio Description
Sample portfolio contains 25 trades (total notional 2.7 bln.) with 1-year maturity, different deal types and underlying assets to avoid high correlation. 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 includes 5 counterparties with legal documents with netting agreements. Portfolio notional is distributed proportionally across netting sets and counterparties.

No collateral or margining agreements were applied (zero collateral balances and infinite margining thresholds) to capture net effect of netting.

Table 1. Non-netted Exposure and PV by Customer (USD, mln.)

<table>
<thead>
<tr>
<th>Customer</th>
<th>EPE</th>
<th>Peak PFE</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMERICAN EXPRESS CO US</td>
<td>5.8</td>
<td>13.4</td>
<td>7.6</td>
</tr>
<tr>
<td>BNP PARIBAS FR</td>
<td>5.6</td>
<td>11.5</td>
<td>2.7</td>
</tr>
<tr>
<td>CITIGROUP US</td>
<td>4.3</td>
<td>9.1</td>
<td>4</td>
</tr>
<tr>
<td>DEUTSCHE BANK DE</td>
<td>0.8</td>
<td>7</td>
<td>-3.8</td>
</tr>
<tr>
<td>EXXON MOBIL CORP US</td>
<td>0.6</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17.1</td>
<td>42.3</td>
<td>11.9</td>
</tr>
</tbody>
</table>

Table 2. Portfolio Summary Statistics (mln, Additional statistics were simulated using PrevioRisk software).

<table>
<thead>
<tr>
<th>Number of Trades</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notional</td>
<td>2.7 bln</td>
</tr>
<tr>
<td>PV</td>
<td>12 mln</td>
</tr>
<tr>
<td>Maturity</td>
<td>1 year</td>
</tr>
<tr>
<td>Number of Counterparties</td>
<td>5</td>
</tr>
<tr>
<td>Number of Netting Sets</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 2. Portfolio segmentation by Counterparty (top level), netting sets (middle) and trade PFE (USD, mln).
Netting Cases

We simulate three cases for selected portfolio:

Case 1. No netting across trades: single trade is netting set, all netting agreements are disabled. Total portfolio exposure is:

\[ E^0 = \sum_{i} \max(E_i, 0), \]

where \( i \) – single trade.

Case 2. Netted portfolio across trades: only legal document netting is applied to trades. Customers have 1 or 2 legal documents. Total portfolio exposure is:

\[ E^{\text{netted}} = \sum_{i} E(n) + \sum \max(E_i, 0), \]

where \( i \) – trades which does not belong to netting set, \( E(n) \) – netting set \( n \) exposure, \( N \) – number of netting sets. As can be seen from above, trades which do not belong to netting agreement are represented as separate netting sets.

Case 3. All netted: trades are netted according to legal agreements and netting set exposures are netted on customer level (shows the effect of adding a Master Netting Agreement). We use this case to show aggregated risk position of portfolio:

\[ E^{\text{all}} = \max(\sum_{n=1}^{N} E(n) + \sum_{i} E_i, 0). \]

Simulation Results

Table below shows peak Potential Future Exposure on counterparty level. As expected, PFE is significantly lower when netting is applied.

<table>
<thead>
<tr>
<th>Customer</th>
<th>No. Deals</th>
<th>Non-Netted</th>
<th>Netted</th>
<th>All Netted</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMERICAN EXPRESS CO US</td>
<td>10</td>
<td>6.4</td>
<td>3.4</td>
<td>3.3</td>
</tr>
<tr>
<td>BNP PARIBAS FR</td>
<td>6</td>
<td>12.8</td>
<td>10.2</td>
<td>9.8</td>
</tr>
<tr>
<td>CITIGROUP US</td>
<td>4</td>
<td>11.0</td>
<td>5.6</td>
<td>5.8</td>
</tr>
<tr>
<td>DEUTSCHE BANK DE</td>
<td>3</td>
<td>1.2</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>EXXON MOBIL CORP US</td>
<td>2</td>
<td>8.5</td>
<td>7.5</td>
<td>6.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>40.1</strong></td>
<td><strong>28.0</strong></td>
<td><strong>26.4</strong></td>
</tr>
</tbody>
</table>

Figure 3. Max PFE by Customer (USD, mln.)

Mitigation effects of netting for customer with largest number of trades is close to 50% of non-netted PFE. For other customers it is lower.

Total aggregated netting benefit is 48% for legal document netting and 52% for Master Netting Agreement netting.

Figure 4. Portfolio max PFE (USD, mln.)

IRS and CDS Portfolio Simulation

Portfolio Description
This portfolio contains 50 Interest Rate Swaps (total notional 10 bln.) with maturity from 5 to 10 years. Transactions are performed in different currencies.

Portfolio was simulated for “non-netted”, “netted” by 5 legal documents and “all netted” cases.

No collateral or margining agreements were applied (zero collateral balances and infinite margining thresholds) to capture net effect of netting.

Table 4. Portfolio Summary Statistics (mln, Additional statistics were simulated using PrevioRisk software).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Trades</td>
<td>50</td>
</tr>
<tr>
<td>Notional</td>
<td>10 bln</td>
</tr>
<tr>
<td>PV</td>
<td>10 mln</td>
</tr>
<tr>
<td>Maturity</td>
<td>5-10 years</td>
</tr>
<tr>
<td>Number of Netting Sets</td>
<td>5</td>
</tr>
</tbody>
</table>

Simulation Results
Table chart shows peak Potential Future Exposure on portfolio level. PFE is significantly lower when netting is applied. In this case, however, impact of netting benefit is higher compared to previous portfolio.

Portfolio contains trades with highly correlated underlying market factors (interest rates). And, thus, positions of same sign (defined by paid or received floating leg) usually move one exposure direction. Therefore, only positions of opposite signs can offset each other.

Conclusion
Financial institutions can benefit from netting effects when computing exposure and capital requirements for portfolio of derivatives. Higher degree of diversification and additional netting agreements would lead to more significant benefit.

Netting is applied on the stage of PFE aggregation. PFE can be aggregated using three netting methods: netting by existing legal contract, netting all exposure, and netting none.

We demonstrated significant PFE netting benefit for two portfolios and found variation of benefit on customer level.

Netting benefit can be explained by two factors:

Maturity of trades is different for separate trades. Thus, trades with shorter maturity does not offset other trades after maturity.

References
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