Credit risks

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Sommaire

I. Different risks

A. Some past crisis

Year	Crisis	Markets
1974	Bank Herstatt	Bank, Forex, Systemic risk
1979	Rise of the Fed Funds	American monetary market
1980	Corner of silver metal	Metals, energy, agricultural products
1982	Debt of Emerging Markets	Bank, Interest rates, Systemic risk
1985	Bank of New York	Bank, Systemic risk
1987	October 1978 krach	Interest rates, Equity, Systemic risk
1989	Junk bonds	Bank, Interest rates
1989	Japanese bubble	Equity, Real estate, Banks
1990	Invasion of Kuwait	Oil, Interest rates
1992 -1993	EMS crisis	Forex, Interest rates
1994	Correction on bond market	Interest rates
1994	Mexican economic crisis	Forex, Interest rates, Systemic risk
1997	Asian economic crisis	Forex, Bank
1997-1998	Brazil	Forex
1998	Russian crisis (LTCM…)	Interest rates, Systemic risk
2000	Internet bubble	Equity
2000	Turkey	Bank, Interest rates, Forex
2000-?	Zimbabwe	Hyperinflation
2001	11 September	Systemic risk
2001	Junk bonds	Interest rates
2001	Argentinean economic crisis	Forex
2002	Brazil	Bond market, Forex
2007-?	Subprime crisis	Real Estate, Bank, Equity, Systemic risk
2008-?	Credit crisis	Real Estate, Bank, Equity, Systemic risk
2010-2012	Credit crisis	Euro Government bonds, Systemic risk

B. Market risk

1. Definition

It is the risk of losses coming from variations of the market prices.

One buys (or sells) a product at t_0 at the price M_{t_0} and at t_1 the P&L = $P\&L = M_{t_1} - M_{t_0} < 0$. The bank would therefore make a loss if it had to sell this product at t_1. During a long time, the investment banks mainly focused on this type of risk. For example, this type of risk is visible when the bank accounts are published, at least annually but often every half year or quarter. The bonuses being linked to the P&L, there was also more attention on this risk from the management.

2. Some measures of this risk

Let us note

- X the (random) P&L of the portfolio
- Value at risk at the level α:

$$VaR^{\alpha} = -\sup\{x / P(X \leq x) \leq 1 - \alpha\}$$

- Tail conditional expectation at the level α:

$$TCE^{\alpha} = E[X \mid X \leq -VaR^{\alpha}]$$

i.e. the expected loss knowing that we break the VaR limit (we suppose that we lose at least the VaR)

- The expected shortfall at the level α

$$ES^{\alpha} = \lambda\, TCE^{\alpha} + (1 - \lambda) VaR^{\alpha}$$

  Where

$$\lambda = \frac{P(X \leq -VaR^{\alpha})}{1 - \alpha} \leq 1$$

(with equality to 1 if the distribution of the P&L, X is a continuous function)

If-by exception- we are in this last case of continuity, then

$$ES^{\alpha} = TCE^{\alpha} = VaR^{\alpha}$$

If- as in general-we are not in this last case, then

$$ES^{\alpha} \geq TCE^{\alpha} \geq VaR^{\alpha}$$

Quantitative equivalent: one can show that

$$ES^{\alpha}(X) = -\frac{1}{\alpha}\int_0^{\alpha} F^{\leftarrow}(p)dp$$

Where

$$F^{\leftarrow}(p) = \inf\{x \mid F(x) \geq p\}$$

(the "generalized inverse" function of F(x))

3. Rem

VaR is an insufficient risk measure in itself because

- It is a too optimistic view

  As an example, a 95% VaR indicates that when everything is "fine" (95% of the cases, including bad cases), the Bank should not lose more than VaR. But it doesn't say anything at all on how much the Bank risks to lose in the 5% remaining very bad cases!

Back testing may say that the number of outliers is in line with VaR: it is neither the case during crises or on the size of losses. One of the reasons is that some risk factors may be stable (their value does not change much) during benign periods, then be not taken into account in the data used to compute VaR or have no effect on VaR, but suddenly change during crises.

However, a significant increase of VaR may be a meaningful signal of a change of regime. As an example, before the 2007 crisis, a VaR increased from 30MEUR to 160MEUR. The Losses were actually in the order of magnitude of several GEUR.

- Effects such as illiquidity, wrong compensations, systemic risk not taken into account
- When portfolios get distressed, hidden cost of hedging will get more visible

C. Liquidity risk

In finance, the liquidity risk is the risk that a given security or asset cannot be traded quickly enough in the market to prevent a loss (or make the required profit).

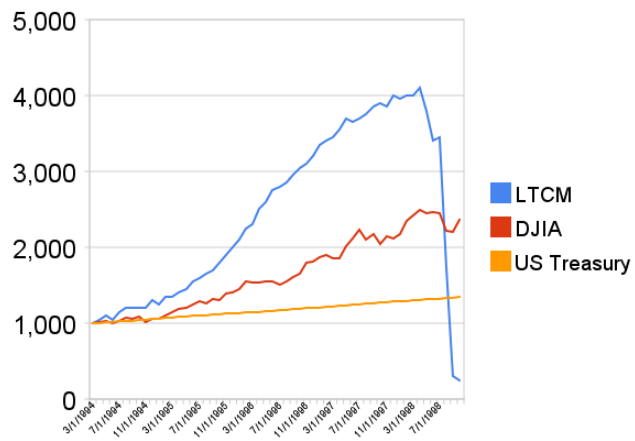
One example is CDS of ABS in 2009 (+ JK).

It can be also to have not enough liquidity to fulfill the bank's engagements.

Here is the example of LTCM (in 1997-1998):

The convergence of the bond markets of the future Euro zone coming from the monetary union of January 1999 provides initially easy and important profits to LTCM due to leverage ratio very important.

The fund LTCM has then, unknown to everybody, positions completely unthinkable for the time, which represent more than 1200 billion of dollars, for example the equivalent of the France GDP at the beginning of the years 1990. After the Asian crisis of 1997, LTCM bets that the bond rates will come back to normal by the end of 1998, except that the Asian crisis propagates to Russia. At the end of summer 1998, the default of the Russia Federation, during the financial Russian crisis of 1998, creates another shock on the bond markets that goes to exact opposite of LTCM anticipations. LTCM sees then its capital disappearing almost instantaneously, in few days.



The value of $1,000 invested in LTCM,[17] the Dow Jones Industrial Average and invested monthly in U.S. Treasuries at constant maturity.

« LTCM » par JayHenry — Travail personnel. Sous licence Domaine public via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:LTCM.png#/media/File:LTCM.png

1. Types of liquidity risk

Market liquidity – An asset cannot be sold due to lack of liquidity in the market – essentially a sub-set of market risk. This can be accounted for by:

- Widening bid/offer spread
- Making explicit liquidity reserves
- Lengthening holding period for VaR calculations

Funding liquidity – Risk that liabilities:

- Cannot be met when they fall due
- Can only be met at an uneconomic price

It can be name-specific or systemic

D. Operational risk

Operational risk is "the risk of a change in value caused by the fact that actual losses, incurred for inadequate or failed internal processes, people and systems, or from external events (including legal risk), differ from the expected losses". This definition from the Basel II regulations was also adopted by the European union Solvency II Directive.". In October 2014, the Basel Committee on Banking Supervision proposed a revision to its operational risk capital framework that sets out a new standardized approach to replace the basic indicator approach and the standardized approach for calculating operational risk capital.

It can also include other classes of risk, such as fraud, security, privacy protection, legal risks, physical (e.g. infrastructure shutdown) or environmental risks.

Operational risk is a broad discipline, close to good management and quality management.

Operational risks have taken more importance because of the big volumes of positions that are taken and sophistication of processes or products, as shown by the Barings or Société Générale cases.

E. Credit Risk

1. Definition of Credit Risk

Credit risk refers to the risk that a borrower will default on any type of debt by failing to make required payments. The risk is primarily that of the lender and includes lost principal and interest, disruption to cash flows, and increased collection costs. The loss may be complete or partial and can arise in a number of circumstances. For example:

- A consumer may fail to make a payment due on a mortgage loan, credit card, line of credit, or other loan
- A company is unable to repay asset-secured fixed or floating charge debt
- A business or consumer does not pay a trade invoice when due
- A business does not pay an employee's earned wages when due
- A business or government bond issuer does not make a payment on a coupon or principal payment when due
- An insolvent insurance company does not pay a policy obligation
- An insolvent bank won't return funds to a depositor
- A government grants bankruptcy protection to an insolvent consumer or business
- To reduce the lender's credit risk, the lender may perform a credit check on the prospective borrower, may require the borrower to take out appropriate insurance, such as mortgage insurance or seek security or guarantees of third parties. In general, the higher the risk, the higher will be the interest rate that the debtor will be asked to pay on the debt.

2. Types of credit risk

Credit risk can be classified as follows:

- Credit default risk — The risk of loss arising from a debtor being unlikely to pay its loan obligations in full or the debtor is more than 90 days past due on any material credit obligation; default risk may impact all credit-sensitive transactions, including loans, securities and derivatives.
- Concentration risk — The risk associated with any single exposure or group of exposures with the potential to produce large enough losses to threaten a bank's core operations. It may arise in the form of single name concentration or industry concentration.
- Country risk — The risk of loss arising from a sovereign state freezing foreign currency payments (transfer/conversion risk) or when it defaults on its obligations (sovereign risk); this type of risk is prominently associated with the country's macroeconomic performance and its political stability.

Counterparty Credit risk: credit risk for a given counterparty.

3. Some mitigations

- Diversification: spreading exposure to different counterparties
- Netting: being legally allowed offsetting positive and negative contract with the same counterparty in case of its default.
- Collateralization: holding cash or securities against exposure (equivalent of a guarantee deposit)
- Hedging: trading instruments such as credit derivatives to reduce exposure and counterparty risk.

II. Overview of the regulatory mitigation

Current regulations: Basel I, Basel II; Basel 2.5; Basel III; Dodd Frank

A. Basel agreements

A set of international banking regulations put forth by the Basel Committee on Bank Supervision (BCBS), which set out the minimum capital requirements of financial institutions with the goal of minimizing credit risk.

Banks that operate internationally are required to maintain a minimum amount (8%) of capital based on a percent of risk-weighted assets.

The Committee was formed in response to the messy liquidation of Cologne-based Herstatt Bank.

B. Main framework

1. Basel I

The idea is that Banks should keep enough money "for the bad times", or $\frac{Reserves}{Risky\ Capital}$.enough, translated in the applications.

Basel I, that is, the 1988, Basel Accord, is primarily focused on credit risk and appropriate risk-weighting of assets, taking into account that not all the types of capital bear the same riskiness, have the same quality or easiness of availability, hence the split in different Tiers.

Assets of banks were classified and grouped in five categories according to credit risk, carrying risk weights of

- 0% (for example cash, bullion = precious metals, home country debt like Treasuries),
- 20% (securitizations such as mortgage-backed securities (MBS) with the highest AAA rating),
- 50% (municipal revenue bonds, residential mortgages),
- 100% (for example, most corporate debt), and some assets given No rating. Banks with an international presence are required to hold capital equal to 8% of their risk-weighted assets (RWA).

- Tier 1: it is composed of core capital, which consists primarily of common stock and disclosed reserves (or retained earnings),
- Tier 2: the Tier 2 capital represents "supplementary capital" such as undisclosed reserves, revaluation reserves, general loan-loss reserves, hybrid (debt/equity) capital instruments, and subordinated debt.
- Tier 3: capital held by banks to meet part of their market risks, that includes a greater variety of debt than tier 1 and tier 2 capitals.
  Tier 3 capital debts may include a greater number of subordinated issues, undisclosed reserves and general loss reserves compared to tier 2 capital. It is used to support market risk, commodities risk and foreign currency risk.
  To qualify as tier 3 capital, assets must be limited to 250% of a banks tier 1 capital, be unsecured, subordinated and have a minimum maturity of two years.

- Link: http://www.investopedia.com/terms/t/tier3capital.asp#ixzz3YEUUyIOI

The tier 1 capital ratio = tier 1 capital / all RWA

The total capital ratio = (tier 1 + tier 2 + tier 3 capital) / all RWA

Leverage ratio = total capital/average total assets

Banks are also required to report off-balance-sheet items such as letters of credit, unused commitments, and derivatives. These all factor into the risk weighted assets. The report is typically submitted to the Federal Reserve Bank as HC-R for the bank-holding company and submitted to the Office of the Comptroller of the Currency (OCC) as RC-R for just the bank.

From 1988 this framework was progressively introduced in member countries of G-10, comprising 13 countries as of 2013: Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, Netherlands, Spain, Sweden, Switzerland, United Kingdom and the United States of America.

Over 100 other countries also adopted, at least in name, the principles prescribed under Basel I. The efficacy with which the principles are enforced varies, even within nations of the Group.

Some links:

- http://www.investopedia.com/terms/b/basel_i.asp
- http://en.wikipedia.org/wiki/Basel_I

2. Basel II

Basel II was initially published in June 2004

It attempts to integrate Basel capital standards with national regulations, by setting the minimum capital requirements of financial institutions with the goal of ensuring institution liquidity.

Its purpose was to create standards and regulations on how much capital financial institutions must have put aside.

Generally speaking, these rules mean that the greater risk to which the bank is exposed, the greater the amount of capital the bank needs to hold to safeguard its solvency and overall economic stability.

Advocates of Basel II believed that it could help protect the international financial system should a major bank or a series of banks collapse.

However, it was politically difficult to implement Basel II in the regulatory environment prior to 2008, and progress was generally slow until that year's major banking crisis caused mostly by credit default swaps, mortgage-backed security markets and similar derivatives

Some links:

- http://www.investopedia.com/terms/b/baselii.asp
- http://en.wikipedia.org/wiki/Basel_II

3. Basel 2.5

The Basel 2.5 regulations are a series of rules that regulate the capital charges on banking institutions on the market risk of their trading books.

The main purpose of Basel 2.5 is to strengthen the capital charge regime by increasing the capital charge significantly. This has been motivated by the Credit Crunch and as such there is a big emphasis on credit related products.

There are four main areas that Basel 2.5 concentrates on:

1. Stressed VaR (SVaR)

This adds an additional VaR based requirement to the calculation on capital requirements. The idea behind Stressed VAR is to capture the more extreme or tail conditions that VaR does not capture and adjust the capital requirement accordingly.

2. Incremental Risk Charge (IRC)

This charge was introduced in Basel 2.5 to capture default and credit migration risk.

3. Comprehensive Risk Measure (CRM)

This charge was introduced in Basel 2.5 to deal with correlation risk.

4. Standardised charges for securitisation and resecuritisation positions

Each of these measures will generate a capital requirement which is then simply added on to the existing capital charge as calculated by Basel II. This Basel 2.5 framework does not allow for offsets, so all the charges have to be taken on.

4. Basel III

Summary of originally (in 2010) proposed changes

1. First, the quality, consistency, and transparency of the capital base will be raised.

2. Second, the risk coverage of the capital framework will be strengthened.
   - Promote more integrated management of market and counterparty credit risk and strengthened risk management of counterparty credit exposures (e.g. WWR)
   - Add the CVA-risk due to deterioration in counterparty's credit rating
   - Strengthen the capital requirements for counterparty credit exposures arising from banks' derivatives, repo and securities financing transactions
   - Raise the capital buffers backing these exposures and reduce procyclicality
   - Provide additional incentives to move OTC derivative contracts to CCPs.

3. Third, a leverage ratio will be introduced as a supplementary measure to Basel II intended to achieve the following objectives:
    - Put a floor under the build-up of leverage in the banking sector
    - Introduce additional safeguards against model risk and measurement error by supplementing the risk based measure with a simpler measure that is based on gross exposures.

4. Fourth, a series of measures for "Reducing procyclicality and promoting countercyclical buffers"
    - Measures to address procyclicality:
        - Dampen excess cyclicality of the minimum capital requirement; Promote more forward looking provisions;
        - Conserve capital to build buffers at individual banks and the banking sector that can be used in stress; and
    - Achieve the broader macro prudential goal of protecting the banking sector from periods of excess credit growth.
        - Requirement to use long term data horizons to estimate probabilities of default,
        - downturn loss-given-default estimates, recommended in Basel II, to become mandatory
        - Improved calibration of the risk functions, which convert loss estimates into regulatory capital requirements.
        - Banks must conduct stress tests that include widening credit spreads in recessionary scenarios.
    - Promoting stronger provisioning practices (forward looking provisioning):
        - Advocating a change in the accounting standards towards an expected loss (EL) approach (usually, EL amount := LGD*PD*EAD).

5. Fifth, a global minimum liquidity standard

    It includes a 30-day liquidity coverage ratio requirement underpinned by a longer-term structural liquidity ratio called the Net Stable Funding Ratio. (In January 2012, the oversight panel of the Basel Committee on Banking Supervision issued a statement saying that regulators will allow banks to dip below their required liquidity levels, the liquidity coverage ratio, during periods of stress)

The Committee is also reviewing the need for additional capital, liquidity or other supervisory measures to reduce the externalities created by systemically important institutions.

Own funds requirements are defined in the article 92 of CRR (see http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R0575):

> ***a) a Common Equity Tier 1 capital ratio of 4,5 %;***
>
> ***b) a Tier 1 capital ratio of 6 %;***
>
> ***c) a total capital ratio of 8 %.***

Some links:

- http://en.wikipedia.org/wiki/Basel_III
- http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R0575

5. Dodd-Franck

- Dodd-Frank aims at Create a Sound Economic Foundation to Grow Jobs, Protect Consumers, Rein in Wall Street and Big Bonuses, End Bailouts and Too Big to Fail, Prevent Another Financial Crisis
    - Monitoring the performance of companies deemed "too big to fail"
    - Providing money to assist with the liquidation of financial companies that have been placed in receivership because of their financial weakness.
    - The breaking up of large banks if they may become dangerous due to their size
    - Liquidation or restructuring of firms deemed too financially weak
    - Restrictions on the ways banks can invest and regulates trading in derivatives (Volcker Rule), with the need to pass through CCPs
    - Improved accuracy of ratings provided by agencies

- Not immediate to apprehend all the regulation…
    - more than 2,300 pages in the "guidelines", implying around 400 laws that needed to be passed

- On 07/10/2014, regulators have been praised for their implementation of the 2010 Dodd-Frank financial reform law meant to prevent further financial crises.
    - Regulators have finished writing major rules required by Dodd-Frank in 2013
    - However, the Davis Polk law firm, which tracks the implementation of Dodd-Frank regulations, report beginning of October 20104 that already more than 40 percent of 280 deadlines set by the law have been missed.

Some links:

- http://www.banking.senate.gov/public/_files/070110_Dodd_Frank_Wall_Street_Reform_comprehensive_summary_Final.pdf
- http://www.sec.gov/spotlight/dodd-frank.shtml

III. Building blocks in counterparty risk

A. Counterparty Credit Risk and netting

Article 272, page 173 of CRR (as of 2013 11 30) in "CRR Final Regulation No 575 of 2013.pdf"

- "Counterparty credit risk" or "CCR" means the risk that the counterparty to a transaction could default before the final settlement of the transaction's cash flows;
- The Counterparty Credit exposure is the loss incurred in case of default of the counterparty.
- Netting: consolidating the values of two or more transactions, payments or positions in order to create a single value. Netting entails offsetting the value of multiple positions:
- Gross: all the exposures are added
- Two sets of values to consider: let us write $v_d(t_k)$ the value of a deal d at time t_k with a given counterparty
    - If the counterparty defaults at t_k, the exposure is
        - If no netting: $Exposure_{gross}(t_k) = \sum_{d=1}^{TotalTrades} \max(v_d(t_k), 0)$
        - Case of netting: $Exposure_{net}(t_k) = \max\left(\sum_{d=1}^{TotalTrades} v_d(t_k), 0\right)$
        - $EE(t_k) = max(v_d(t_k), 0)$

1. Netting

a) Definition

- A netting agreement is a legally binding contract that allows aggregation of transactions.
- A netting set corresponds to a set of trades that can be legally netted together in the case of a default.

Rem1: if a trade T_1 does not net with the rest of the trades, we have $\{T_1\}$ is a netting set of its own.

Rem2:

- within a netting set, MtM is added
- Across netting sets, exposures are added

b) Example

With trades of respective values: 7; -4; 5; 2; -4, the total exposure is

- 14 without netting
- 6 with netting

c) CSA and ISDA Master Agreement

A Credit Support Annex, or CSA, is a legal document which regulates credit support (collateral) for derivative transactions.

A CSA defines the terms or rules under which collateral is posted or transferred between swap counterparties to mitigate the credit risk arising from "in the money" derivative positions

The ISDA (International Swaps and Derivatives Association) published a document that received legal opinion in most relevant jurisdiction.

This document is designed to eliminate legal uncertainties and to provide mechanisms for mitigating counterparty risk.

B. Collateral

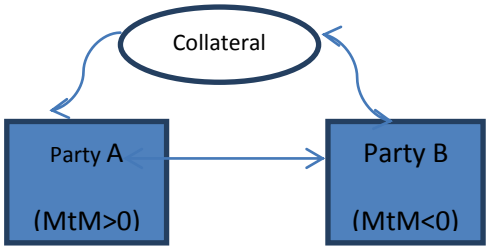
1. Collateral (or margin)

a) Definition

Collateral is an asset supporting a risk in a legally enforceable way.

Rems

- It can be cash or other securities, the characteristics of which have been agreed before initiation of the contract.
- It is a “guaranty deposit” of financial assets, by a counterparty, pledged in case of its default
- In essence, the value of the collateral is the value of the exposure and is therefore readjusted continuously
- In practice, time is necessary due to operational constraints. Therefore, depending on the portfolios, the margin call frequency can be daily or longer



- If MtM>0: call for collateral
- If MtM<0: post collateral

“Ideally”, MtM + Collateral = 0

b) Collateral process

1) The parties negotiate and sign a collateral support document (CSA = Credit Support Annex, one of the four parts of an ISDA Mater Agreement)
2) Trades subject to collateral are regularly Marked-to-Market (frequency to be defined) and the overall valuation (including netting as appropriate) is agreed (or disputed…)
3) The party with negative MtM posts collateral (subject to some operational conditions, such as Minimum Transfer Amount and thresholds, see later)

4) The collateral balance is updated and the exposure computed

Rem If a $t + \Delta t$

- $0 < M_{t_1} < M_{t_2}$ then B should post $M_{t_2} - M_{t_1}$ (called variation margin)
- $0 < M_{t_2} < M_{t_1}$ then A should post (return) $M_{t_1} - M_{t_2}$

The collateral agreement should cover the necessary parameters:

- Base of currency
- Type of agreement (one-way or two-way)
- Eligible collateral
- Margin call frequency, notification times and delivery periods
- Interest rates payable for the cash collateral
- Other parameters (defined later in the course): Independent Amount, MTA, Threshold, haircuts

c) Margin call frequency

Margin call frequency refers to the periodic time scale with which collateral may be called and returned.

- Intraday common for some products such as repos (the sale of securities together with an agreement for the seller to buy back = repurchase the securities at a later date)
- Often: daily
- Can be also weekly, biweekly, monthly, annually (ex: for small counterparty struggling with operational and funding requirements)

2. Thresholds

It is the level of exposure below which collateral will not be called. It represents therefore an amount of uncollateralized exposure.

If $M_t > Threshold$ then only $M_t - Threshold$ is called for collateral

3. Independent Amount (IA)

IA, also sometimes referred to as Independent Margin (IM), corresponds to a quantity of collateral that is posted upfront and is independent of any subsequent collateralization. It therefore corresponds to a level of overcollateralization.

4. Minimum Transfer Amount (MTA)

It is the smallest amount of collateral that can be transferred. It is used to avoid workload associated to the transfer of insignificant amounts of collateral.

Rem: MTA and Th are additive in the sense that the exposure must exceed the sum of the two before any collateral can be called. However, MTA cannot be incorporated in the Th because it would be incorrect in terms of collateral due.

5. Rounding

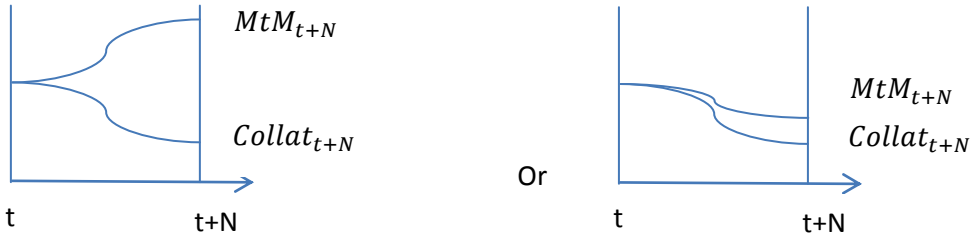
A collateral call or return amount will always be rounded to a certain lot size to avoid unnecessary small amounts. It may be always up (or down) or it can always be to the favor of one counterparty.

6. Haircuts

a) Definition

It is a discount applied to the value of collateral to account for the fact that its value may deteriorate over time compared to the exposure that it should mitigate.

Cash collateral (if in the same currency as the MtM of the portfolio) would require no haircut.



- One should then have $Market\ value\ of\ posted\ security$=($Collateral\ value\ to\ post$)/$Haircut$
- Haircut comes from the
    - Time to liquidate the collateral and therefore its liquidity needs to be taken into account
    - Volatility of the collateral

b) Dependencies

Some important points to take into account before assigning a haircut are:

- Time to liquidate the collateral
- Volatility of the underlying market variable(s) defining the value of the collateral
- Default risk of the security
- maturity of the security
- Liquidity of the security

7. Numerical example

The convention used in the calculation is that the rounding is always in favor of party A (for A, a positive collateral call number is rounded up and a negative collateral call number is rounded down)

	Party A viewpoint	**Party B viewpoint**
Portfolio MtM	371,628	-371,628
IA	-	-
Th	-	-
Collateral held	-	-
MTA	100,000	100,000
Rounding	50,000	50,000
Credit Support Amount	371,628	-371,628
Less collateral held	371,628	-371,628
Call or return amount	400,000	-400,000

	Party A viewpoint	Party B viewpoint
Portfolio MtM	254,234	-254,234
IA	-	-
Th	-	-
Collateral held	400,000	-400,000
MTA	100,000	100,000
Rounding	50,000	50,000
Credit Support Amount	254,234	-254,234
Less collateral held	-145,766	145,766
Call or return amount	-100,000	100,000

8. Netting and Close-out

These two features are often combined.

a) Close-out

Definition: close-out is the right for a counterparty to terminate contracts unilaterally under certain specified conditions.

Termination cancels the contracts and creates a claim for compensation based on the cost of replacing the contract on identical terms with another counterparty.

Collateral agreement reduces the exposure by the amount of collateral held as of the last rebalancing. However the firm remains exposed to closeout risk – the difference between the exposure as of the last rebalancing and the actual cost of close-out or replication

Close out risk has an element of gap risk – the possibility of a market crash between the time the counterparty defaulted and the time when close-out is completed

b) Close-out netting

Two different types of netting:

- Payment netting: agreement to have daily payments consolidated into only one
- Close-out netting: the right to offset amounts due at termination of individual contracts between the same counterparties when determining the final obligation. It covers the netting of the value of contracts in the event of a counterparty defaulting at some date in the future.

Benefit for the counterparty which may close-out

Close-out limits the uncertainty that an institution has about the value of their positions with the defaulted counterparty.

Detriment for the other counterparty

The termination changes the payment amounts immediately due to and from the solvent company and may catalyze financial difficulties for the other company.

9. Margin period of Risk (MPoR)

a) Definition

It is the time period:

- From the most recent exchange of collateral covering a netting set of transactions with a defaulting counterparty
- Until the transactions are closed out and the resulting market risk is re- hedged

b) Computation of MPoR

Article 285, page 183 of CRR (as of 2013 11 30) in "CRR Final Regulation No 575 of 2013.pdf"

$$\text{Margin Period of Risk} = F + N - 1$$

- N is the frequency of re-margining
- F is a formula defined in this article 285, which increases in particular with
    - The difficulty to replace the trades in the portfolio
    - The illiquidity of the collateral
    - The number of trades in the netting set exceeding 5,000 trades at any point during a quarter

(F is floored at 20 days in each of the above cases)

- The number of disputes

"*If an institution has been involved in more than two margin call disputes on a particular netting set over the immediately preceding two quarters that have lasted longer than the applicable margin period of risk under paragraphs 2 and 3, the institution shall use a margin period of risk that is at least double the period specified in paragraphs 2 and 3 for that netting set for the subsequent two quarters.*"

C. PFE and CVA

1. PFE

The Potential Future Exposure (PFE) at a time t is the equivalent of the VaR on MtM

The PFEα at the level α (usually 95% or 99%) is the maximum exposure value at t with a probability of α:

$$\text{Proba}(\text{Exposure} \leq \text{PFE}\alpha) = \alpha$$

Equivalently, the probability that the exposure exceeds PFEα is (at most) 1-α.

PFE is used to determine limits: the institution does not want to take more risk that an amount based on PFE.

2. Credit Valuation Adjustment (CVA)

Article 283, page 225 of CRR (as of 2013 11 30) in "CRR Final Regulation No 575 of 2013.pdf"

$$CVA = LGD_{MKT} \cdot \sum_{i=1}^{T} max\left\{0, \exp(-\left(\frac{s_{i-1} \cdot t_{i-1}}{LGD_{MKT}}\right) - exp\left(\frac{s_i \cdot t_i}{LGD_{MKT}}\right)\right\} \cdot \frac{EE_{i-1} \cdot D_{i-1} + EE_i \cdot D_i}{2}$$

where

t_i = the time of the i-th revaluation, starting from $t_0 = 0$;

t_T = the longest contractual maturity across the netting sets with the counterparty;

s_i = is the credit spread of the counterparty at tenor ti, used to calculate the CVA of the counterparty. Where the credit default swap spread of the counterparty is available, an institution shall use that spread. Where such a credit default swap spread is not available, an institution shall use a proxy spread that is appropriate having regard to the rating, industry and region of the counterparty;

LGD_{MKT} = the LGD of the counterparty that shall be based on the spread of a market instrument of the counterparty if a counterparty instrument is available. Where a counterparty instrument is not available, it shall be based on the proxy spread that is appropriate having regard to the rating, industry and region of the counterparty.

The first factor within the sum represents an approximation of the market implied marginal probability of a default occurring between times t_{i-1} and t_i;

EE_i = the expected exposure to the counterparty at revaluation time t_i, where exposures of different netting sets for such counterparty are added, and where the longest maturity of each netting set is given by the longest contractual maturity inside the netting set; An institution shall apply the treatment set out in paragraph 3 in the case of margined trading, if the institution uses the EPE measure referred to in point (a) or (b) of Article 285(1) for margined trades;

D_i = the default risk-free discount factor at time ti, where $D_0 = 1$.

D. Other features (IA, Haircut, threshold and MTA)

1. Initial amount

An Initial Amount (sometimes also called initial margin) may have to be posted upfront. It can be seen as a level of overcollateralization.

2. Haircut

- A discount on the collateral value (the "haircut") can be applied to take into account its possible deterioration over time

3. Thresholds & Minimum Transfer Amount

To reduce the operational burden: Thresholds & Minimum Transfer Amount

- Below a certain level of exposure (the "threshold") the collateral may be not called,

- The counterparties can agree on a minimum transfer amount ("MTA") of collateral that will be posted.

E. EPE, ENE, EEE, EEPE and RWA

1. EE

If the counterparty defaults at t_k, the exposure is

- If no netting: $Exposure_{gross}(t_k) = \sum_{d=1}^{TotalTrades} \max(v_d(t_k), 0)$
- Case of netting: $Exposure_{net}(t_k) = \max\left(\sum_{d=1}^{TotalTrades} v_d(t_k), 0\right)$
- $EE(t_k) = max(v_d(t_k), 0)$

2. EPE and ENE

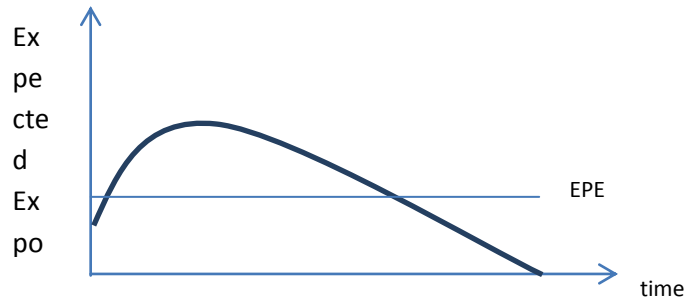
PFE corresponds to a "maximum" exposure (VaR equivalent) at a given time horizon and we now consider the average exposure at this horizon.

a) Definition

Expected positive exposure (EPE) is defined as the average EE through time and hence can be a useful single number representation of exposure

Expected negative exposure (ENE) is defined in a similar way but from our counterparty viewpoint, i.e. MtM replaced by –MtM.

b) Graph



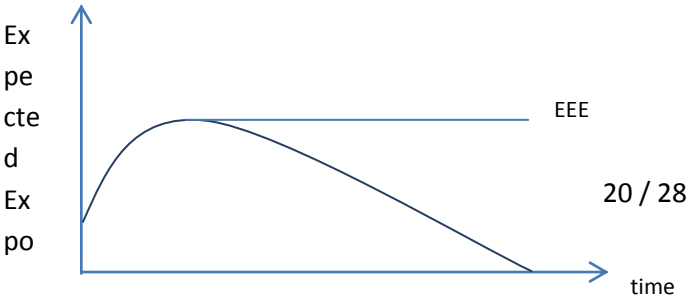
3. EEE

a) Definition

The effective expected exposure (EEE) at time t_k is defined recursively:

$$\begin{cases} EEE_{t_0} = current\ exposure = V^+(t_0) \\ EEE_{t_k} = \max\left(EEE_{t_{k-1}}, EE_{t_k}\right) \end{cases}$$

b) Graph



4. EEPE

EEPE is defined in the article 284, page 181 of CRR (as of 2013 11 30) in “CRR Final Regulation No 575 of 2013.pdf”

a) Definition

Effective EPE shall be calculated by estimating expected exposure (EEt) as the average exposure at future date t, where the average is taken across possible future values of relevant market risk factors. It is the average Effective EE during the first year of future exposure

Then, EEPE is defined as

$$Effective\ EPE = \sum_{k=1}^{\min\{1\ year,\ maturity\}} Effective\ EE_{tk} \cdot \Delta\ t_k$$

where the weights $\Delta t_k = t_k - t_{k-1}$ allow for the case when future exposure is calculated at dates that are not equally spaced over time

Rem: the two regulatory definitions (in word vs. formula) are different…

5. RWA

Risk Weighted Assets (RWA): $RWA = EAD * 12.5 * K(PD, LGD, M) * 1.06$

where

$EAD = \alpha . EEPE$

$$K = LGD \cdot \left[N\left(\frac{N^{-1}(PD) + \sqrt{R} \cdot N^{-1}(0.999)}{\sqrt{1-R}} \right) - PD \right] \cdot RW(M, PD)$$

α = 1.4, unless competent authorities require a higher α or permit institutions to use their own estimates in accordance with paragraph 9 of Article 284

IV. Credit Derivatives

a) Definition

A "credit default swap" (CDS) is a credit derivative contract between two counterparties. The buyer makes periodic payments to the seller, and in return receives a payoff if an underlying financial instrument defaults or experiences a similar credit event. The CDS may refer to a specified loan or bond obligation of a “reference entity”, usually a corporation or government.

A CDS is linked to a "reference entity" or "reference obligor", usually a corporation or government. The reference entity is not a party to the contract. The buyer makes regular premium payments to the seller, the premium amounts constituting the "spread" charged by the seller to insure against a credit event. If the reference entity defaults, the protection seller pays the buyer the par value of the

bond in exchange for physical delivery of the bond, although settlement may also be by cash or auction.

A default is often referred to as a "credit event" and includes such events as failure to pay, restructuring and bankruptcy, or even a drop in the borrower's credit rating. CDS contracts on sovereign obligations also usually include as credit events repudiation, moratorium and acceleration. Most CDSs are in the $10–$20 million range with maturities between one and 10 years. Five years is the most typical maturity.

An investor or speculator may “buy protection” to hedge the risk of default on a bond or other debt instrument, regardless of whether such investor or speculator holds an interest in or bears any risk of loss relating to such bond or debt instrument. In this way, a CDS is similar to credit insurance, although CDS are not subject to regulations governing traditional insurance. Also, investors can buy and sell protection without owning debt of the reference entity. These “naked credit default swaps” allow traders to speculate on the creditworthiness of reference entities. CDSs can be used to create synthetic long and short positions in the reference entity. Naked CDS constitute most of the market in CDS. In addition, CDSs can also be used in capital structure arbitrage.

2. Pricing of a CDS

A CDS has two legs:

- The protection buyer pays a fixed premium periodically until $\min(maturity, default\ (credit\ event)\ time)$
- The protection seller, if default of the reference entity, compensate the buyer for $loss\ of\ notional - recovery\ rate\ \delta$

Value of each leg

- $$V_{premium} = \mathbb{E}\left[\sum_{i=1}^{n} 1_{\{\tau > t_i\}} B(t, t_i) \Delta_{i-1,i} X_{CDS}\right]$$

$$V_{premium} = X_{CDS} \sum_{i=1}^{n} S(t, t_i) B(t, t_i) \Delta_{i-1,i}$$

Where $S(t, t_i)$ is the probability seen at t of survival after t_i

- $$V_{default} = -\mathbb{E}\left[(1-\delta) B(t, \tau) 1_{\{\tau < t\}}\right]$$

$$V_{default} = (1-\delta) \int_t^T B(t, u) dS(t, u)$$

Value of the CDS

$$V_{CDS}(t, T) = V_{premium}(t, T) + V_{default}(t, T)$$

3. Hazard rate

The hazard rate $h(x)$ is defined by $S(t,u) = \mathbb{E}\left[e^{-\int_t^u h(x)dx}\right]$

If the CDS premiums are paid continuously then $V_{premium}(t,T) \sim X_{CDS} \int_t^T B(t,u)S(t,u)du$

If we assume a constant hazard rate then $dS(t,u) = -hS(t,u)du$ and therefore

$$V_{default} = (1-\delta)h\int_t^T B(t,u)S(t,u)du$$

X_{CDS} is such that $V_{CDS}(t,T) = 0$ and therefore $h \approx \frac{X_{CDS}}{1-\delta}$

4. CDS indices

Up until 2004, the majority of credit default swaps were written on single names, but after the introduction of widely accepted credit indices in 2004, the major impetus to growth and liquidity of the credit derivative market has been credit default swaps on indices. A credit index can be usually thought of as an equally weighted combination of single-name CDSs and hence the fair premium on the index will be close to the average CDS premium within that index. The two most common credit indices are:

- DJ iTraxx Europe. This contains 125 European corporate investment-grade reference entities, which are equally weighted.
- DJ CDX NA IG. This contains 125 North American (NA) corporate investment-grade reference entities that are equally weighted.

Other indices exist for different underlying reference entities and regions but they are less liquid. Indices can be traded in either CDS (unfunded) or CLN (funded) form. Buying CDS protection on $125m of the DJ CDX NA IG index is almost equivalent to buying $1m of CDS protection on each of the underlying reference entities within the index.

An important feature of credit indices is that they "roll" every 6 months. A roll will involve:

- Adjustment of maturity. Typical traded maturities are 5 year, 7 year and 10 years. Fixed maturity dates will be used such that the initial maturities are 5.25, 7.25 and 10.25 years. After 6 months the maturities will have become 4.75, 6.75 and 9.75 and these will be re-set to their original values.

- Adjustment of portfolio. Names will be removed from a credit index according to pre-defined criteria in relation to credit events, ratings downgrades and increase in individual CDS premiums beyond a certain threshold. The overall aim is to replace defaulted names and maintain a homogeneous credit quality. Names removed from the index will be replaced with other names meeting the required criteria.

- Premium. In the 6-month period before a roll, the index premium is fixed at a given level and trades on the index will involve an upfront payment from one party to the other to compensate for the difference between the fair premium and traded premium.

5. Links

- http://en.wikipedia.org/wiki/Credit_default_swap
- http://en.wikipedia.org/wiki/Credit_default_swap_index

V. Centralized clearing

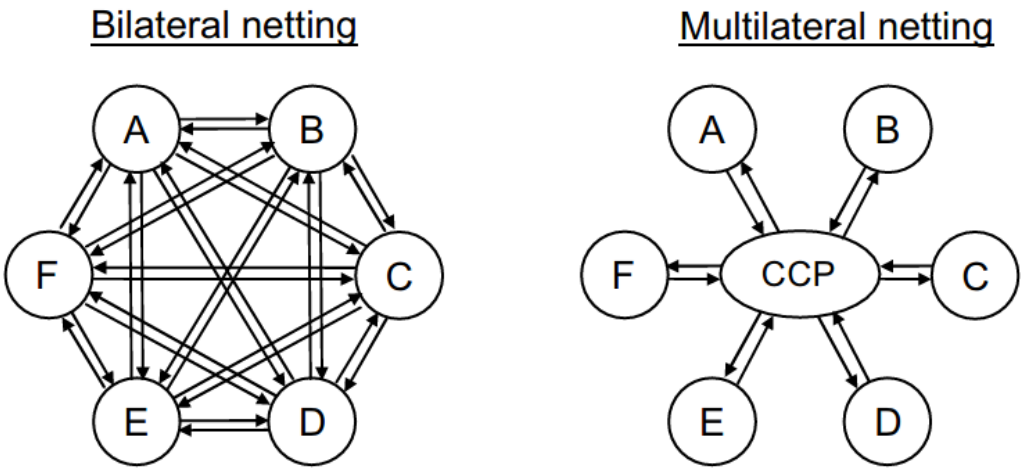
A. Bilateral vs. multilateral netting

A way to eliminate market risk is to take the opposite position. Any negative variation of MtM would be compensated by the opposite variation on the other position.

It does not mean though that the position is riskless: most of the time the hedging position will be taken with another counterparty and it may happen that this new counterparty defaults. The portfolio would not be market hedged anymore. The portfolio is therefore subject to counterparty credit risk. Also, the collateral needs with two counterparties are likely to be larger than with just one.

The aim of a central counterparty (CCP) is to have an entity that stands between parties with respect to some or all contracts traded between them. Because it stands between market buyers and sellers, the CCP bears no net market risk, which remains with the original party to each trade. The CCP, on the other hand, does take the counterparty risk, which is centralised in the CCP structure. As a result, an institution no longer needs to worry about the credit quality of its counterparty, indeed the counterparty to a trade need not even be known. To all intents and purposes, the CCP is the counterparty to the trade.

Whilst the presence of one or more CCPs might seem like a “silver bullet”with respect to counterparty risk, it is not all good news. A CCP must have a fine-tuned structure with respect to collateralisation, settlement and risk management and ultimately must be extremely unlikely to fail. The bigger and better a CCP becomes, the more catastrophic its failure would be. Furthermore, the homogenisation of counterparty risk and removal of the need for institutions to assess their counterparty’s credit quality may cause difficulties due to effects such as moral hazard.



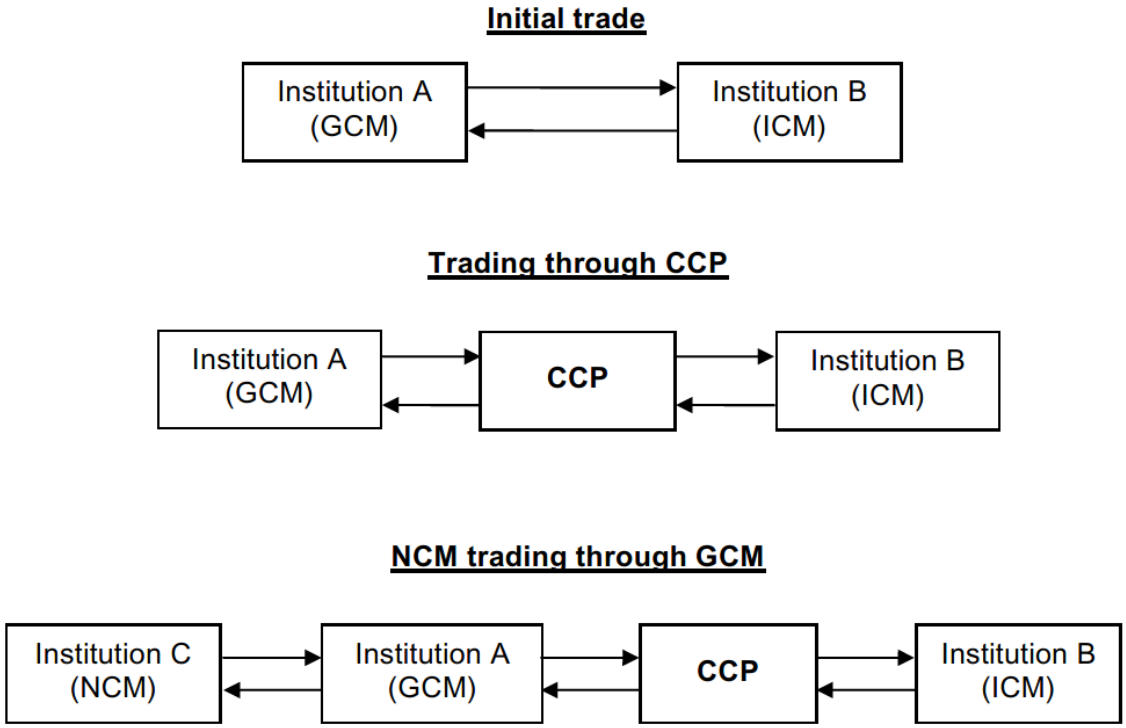
B. Novation

In centrally cleared derivatives markets, the original contract entered into by two parties is automatically replaced by two contracts, each of which arises between one of the original parties and the central counterparty. The legal process whereby the CCP is positioned between buyer and seller is known as novation. Novation is the replacement of one contract with one or more other contracts. The viability of novation depends on the legal enforceability of the new contracts and the certainty that the original parties are not legally obligated to each other once the novation is completed. Because of novation, the contract between the original parties ceases to exist and they therefore do not have counterparty risk to one another. Their only risk lies with the CCP itself.

From the point of view of trading through a CCP, one can consider three types of participant:

- General clearing member (GCM) – member of the CCP who is able to clear third-party trades as well as their own trades.
- Individual clearing member (ICM) – member of the CCP who clears only their own trades.
- Non-clearing member (NCM) – institution having no relationship with the CCP but can trade through a GCM.

All trades of an NCM must be settled through a GCM.



VI. Collateral Management Glossary of Key Terms

Collateral Management Guide PART 2: Collateral Management Glossary

Author: Financial-edu.com

http://www.financial-edu.com/collateral-management-guide-part-2-collateral-management-glossary.php

The following key terms will be useful.

- Add-On: An additional currency amount added on to the mark to market value of an underlying trade or security to offset the risk of non-payment. This represents the credit spread above the default-free rate which one counterparty charges the other based on its internal calculations (often negotiated beforehand and memorialized in a CSA).

- Call amount: the currency amount of collateral being requested by the Taker.

- Capital stock

The capital stock (capitaux propres, also called fonds propres), regroup:

- The initial capital
- The reserve (corresponding to the benefits that have not been redistributed as dividends
- The current results.

Some rules:

- The larger the capital stock, the smaller is the default risk and the higher the expected life of the company.
- If the enterprise has shareholders, its capital stock is increased by the money brought (or left) by y its shareholders, money used for investment (for innovation, to by sites, buildings, machines, etc.) or to pay back debt.

- Credit Support Annex (CSA): a legal agreement which sets forth the terms and conditions of the credit arrangements between the counterparties. The trades are normally executed under an ISDA Master Agreement then the credit terms are formalized separately in a CSA (SEE ALSO Collateral Support Document).

- Collateral Support Document (CSD): a legal agreement which sets forth the terms and conditions that collateralization will occur under in a bi-lateral or tri-lateral / multilateral relationship.

- Give: to transfer collateral to a counterparty to meet a collateral or margin demand. The counterparty with negative mark-to-market (a loss) is usually the collateral Giver. (SEE ALSO Pledge).

- Haircut (SEE Valuation Percentage).

- Independent Amount: An additional amount which is paid above the mark-to-market value of the trade or portfolio. The Independent Amount is required to offset the potential future exposure or credit risk between margin call calculation periods. If daily calculations are used, the Independent Amount offsets the overnight credit risk. If weekly calculations are done, the Independent Amount will usually be higher to offset a large amount of potential mark-to-market movement that can occur in a week versus a day. Many counterparties set the Independent Amount at zero then substitute the Minimum Transfer Amount (MTA) as the Independent Amount on a counterparty-by-counterparty basis.

- Margin: Initial margin is the amount of collateral (in currency value) that must be posted up front to enter into a deal on day 1. Variation margin (a.k.a. maintenance margin) is the amount of collateral that must be posted by either party to offset changes in the value of the underlying deal. Initial margin is generally, but not always, higher than variation margin.

- Margin Call: A request typically made by the party with a net positive gain to the party with a net negative gain to post additional collateral to offset credit risk due to changes in deal value.

- Mark to Market (MTM): Currency valuation of a trade, security, or portfolio based on available comparative trade prices in the open market within a stated time frame. MTM does not take into account any price slippage or liquidity effect that might occur from exiting the deal in the open market, but uses the same or similar transaction prices as indicators of value.

- Mark to Model: Currency valuation of a trade or security based on the output of a theoretical pricing model (e.g. Black Scholes).

- Minimum Transfer Amount (MTA): The smallest amount of currency value that is allowable for transfer as collateral. This is a lower threshold beneath which the transfer is more costly than the benefits provided by collateralization. For large banks, the MTA is usually in the USD 100,000 range, but can be lower.

- Netting: the process of aggregating all open trades with a counterparty together to reach a net mark-to-market portfolio value and exposure estimate. Netting facilitates operational efficiency and reduced capital requirements by taking advantage of reduced risk exposures due to correlation effects of portfolio diversification versus valuing all trades independently. However, netting relies upon efficient and accurate pricing at a portfolio level to be effective.

- Pledge: to give collateral to your counterparty. (SEE ALSO Give).

- Potential Future Exposure (PFE): The estimated likelihood of loss due to nonpayment or other risk, in this case the likelihood of default on a counterparty's obligations.

- Rehypothecation: the secondary trading of collateral. Rehypothecation is the cornerstone of tri-party collateral management.

- Substitution: replacing one form of collateral (e.g. corporate bond) with another form of collateral (e.g. Treasury bond) during the life of a particular deal or trading relationship.

- Take: to receive collateral from a counterparty to meet a collateral or margin demand. The counterparty with positive mark-to-market (a gain) is usually the collateral Taker.

- Threshold Amount: the amount of unsecured credit risk that two counterparties are willing to accept before a collateral demand will be made. The counterparties typically agree to a Threshold Amount prior to dealing, but this is a source of ongoing friction between OTC counterparties and their brokers.

- Top-up: To give additional collateral to your counterparty to meet a margin call.

- Valuation Percentage: a percentage applied to the mark-to-market value of collateral which reduces its value for collaterization purposes. Also known as a "haircut", the Valuation Percentage protects

the collateral Taker from drops in the collateral's MTM value between margin call periods. For example, if the MTM value of the collateral is $100 and the Valuation Percentage = 98.5% then 1.5% is being charged to offset period-to-period valuation risk and the collateral amount counted is only $98.50. The Valuation Percentage offered by different counterparties and brokers may vary in the market, so buy side participants often "haircut shop" for the best rate.

VII. References

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